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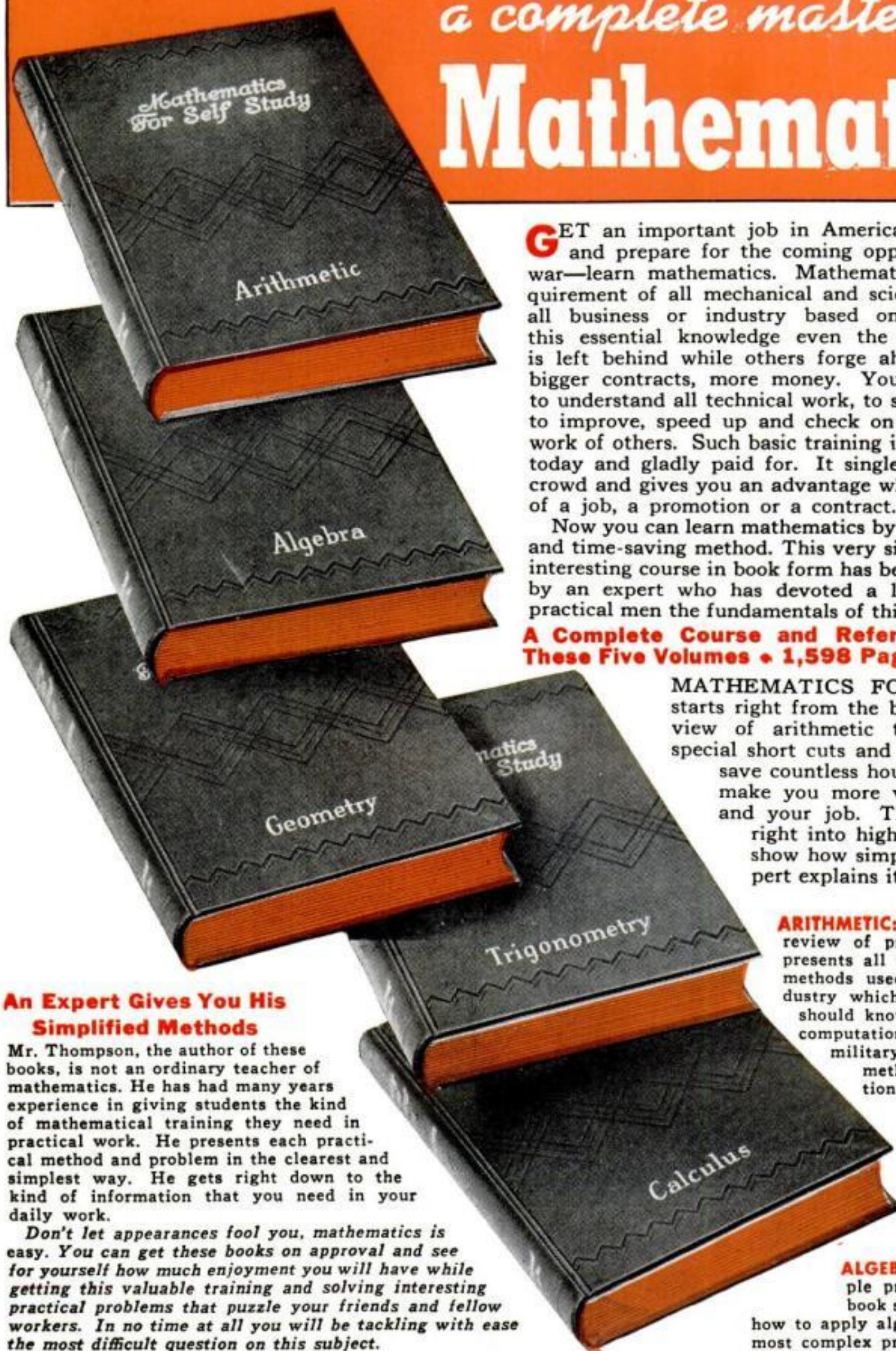
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(Continued on next page)

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MATHEMATICS for Self Study

by J. E. Thompson, B.S. in E.E., A.M., Dept. of Mathematics, Pratt Institute

(Continued from facing cover)

solve problems which are involved in all military and industrial work, relating to machines, engines, projectiles, ships, planes, etc. Logarithms and slide rule, and many other practical applications.

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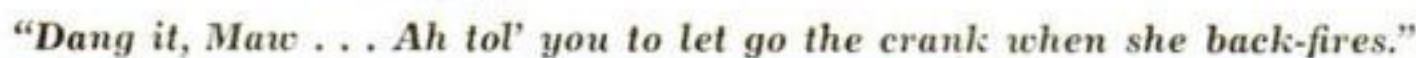
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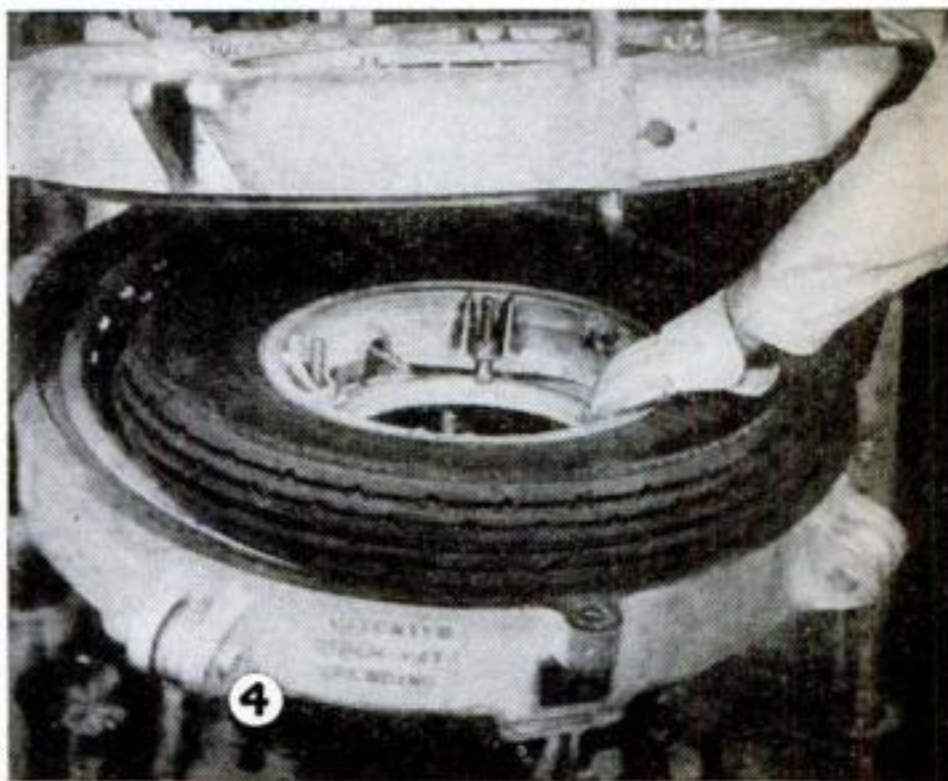
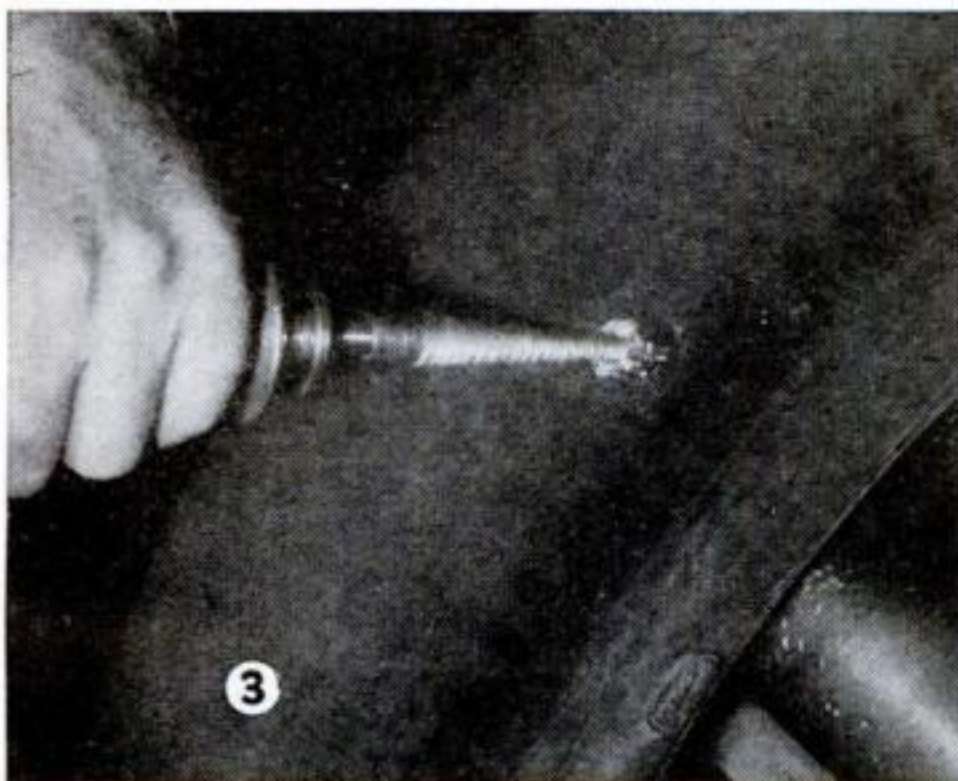
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POP. SCIENCE 11-44

IN SERVICE ON EVERY FRONT





Scratch a tire's face to give it extra miles

Life begins at 40,000 miles for many tires that might once have gone to the scrap pile.

THE MASKED man (above) is scratching the tread off a tire. He wears the mask so it won't scratch him back.

When he gets through this scratching, or buffing, the tire's face will look like the next picture (2), frazzled and treadless.

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When the new tread is on, the tire goes into the mold for "baking." When it comes out (picture 4), the recapper knows that it will give mileage and service worthy of the name B. F. Goodrich.

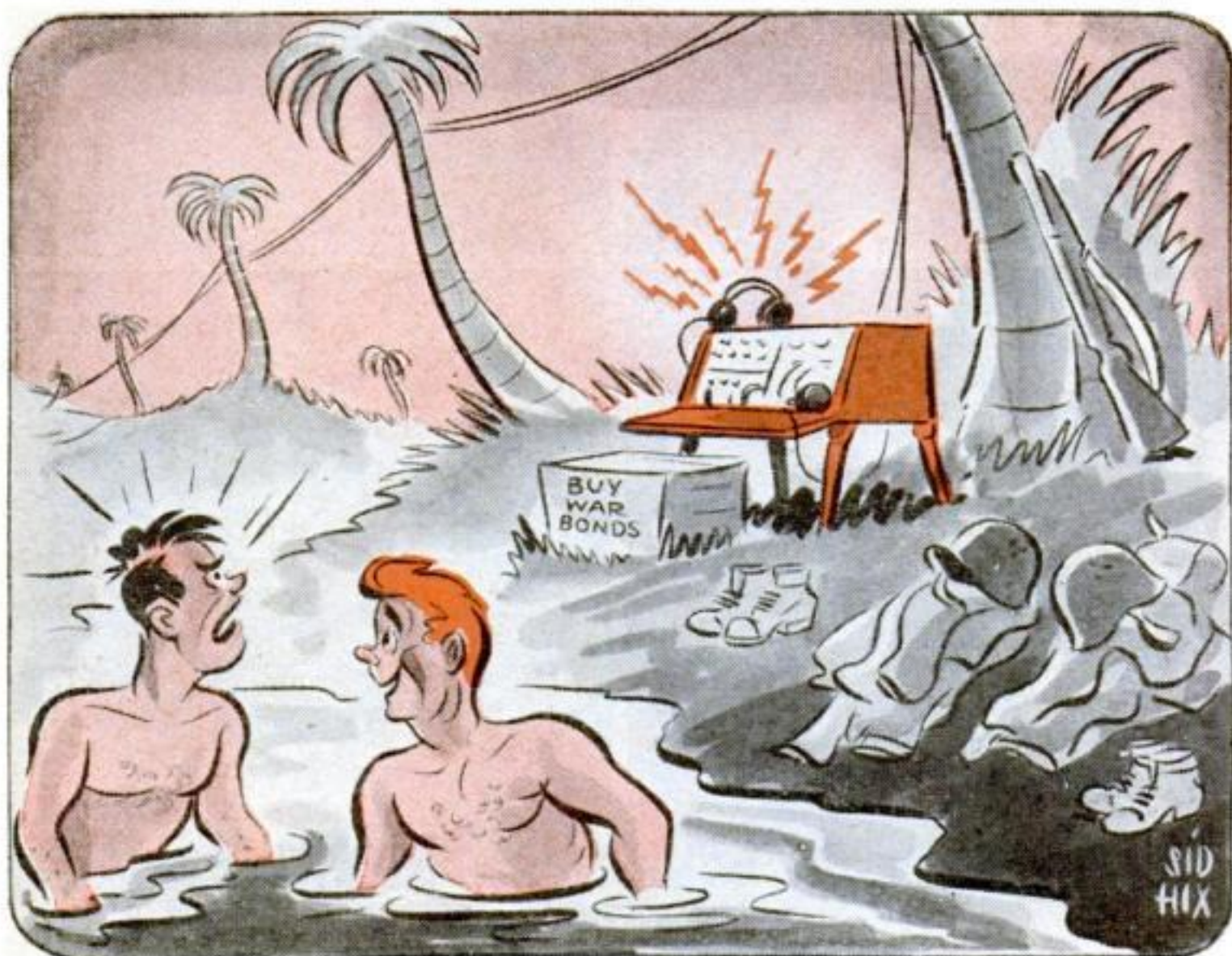
If you are an "A" driver, recapping is the only way you may be able to get a "new" tire for many months. This is also true for many "B" and "C" drivers as well.

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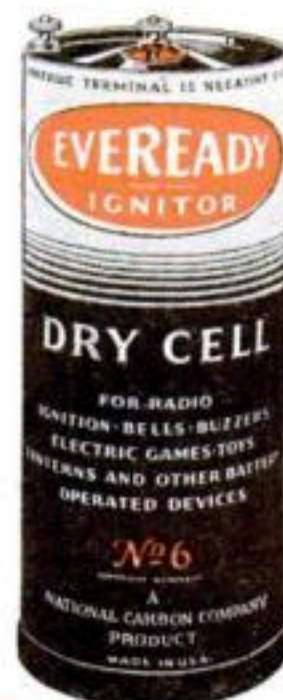


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NOVEMBER, 1944

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5

POPULAR SCIENCE

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MONTHLY

VOL. 145 NO. 5

Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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FAKE MEDIUMS, wholesale bilkers of the public for years, are now stealing millions by trading on the grief of those who have lost loved ones in the war. Julien J. Proskauer (left), past president of the Society of American Magicians, and Theodore Hardeen, brother of Houdini and board chairman of the Magicians' Guild, demonstrate the old table-levitation trick, one of the more popular spiritualistic hoaxes. For a startling exposé of this flourishing racket, read Helen Worden's story on page 67.

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WIDE-EYED EXCITEMENT will be caused among the kiddies this Christmas when you produce the easily made toys described and pictured in full color next month. There's a hen that ducks her head, flaps her wings, and bobs her tail; a cowboy who rides a bucking bronco; a monkey that pedals a bicycle and tips his hat. Besides the pictures, there are working drawings, so you can start right in.

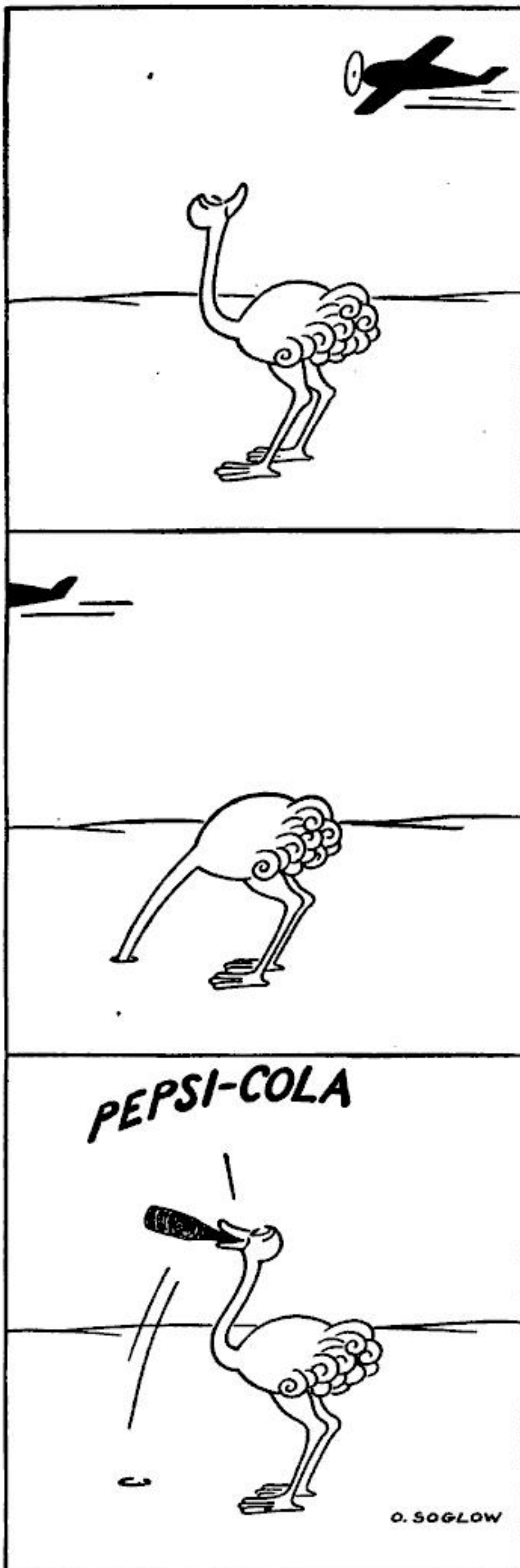
WAR-FRONT REPORT gives you a new line on the Browning automatic rifle, called the "BAR" by the battle-toughened Yanks who use it. You have read about this great gun from the point of view of production and home-front testing. Now Allen Raymond, famous war correspondent, gives a firsthand account of the way the Browning automatic fits into the rough-and-tumble pattern of combat.

THE VICIOUS KINGCOBRA P-63, a deadlier, faster plane than its smaller brother, the P-39 Airacobra, is next month's pin-up in full Kodachrome color. It is a thrilling and indispensable addition to the beautiful series of airplane pin-ups already published.

INSPECTION BY MAGNETISM is accomplished efficiently in many war plants. Hidden defects are made visible by magnetizing iron and steel parts and spraying on a solution containing particles that will be held by the magnetic field built up at the edges of any fault. You can duplicate the method at home if you read this article.

KNOW-YOUR-ENEMY idea is hammered home in an article for builders of model airplanes. There are full directions for constructing a miniature of the German standard fighter plane ME 109-G—the familiar Messerschmitt. Accompanying these are working drawings and a photograph showing the completed model.

HUNDREDS OF OTHER PHOTOGRAPHS, drawings, and diagrams, and scores of other articles of scientific interest add up to an issue of unusual interest.



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A TESTED WAY TO

LESSON FREE

at Home in Spare Time to

TECHNICIAN



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Many Beginners Soon Make \$5, \$10, a Week EXTRA in Spare Time

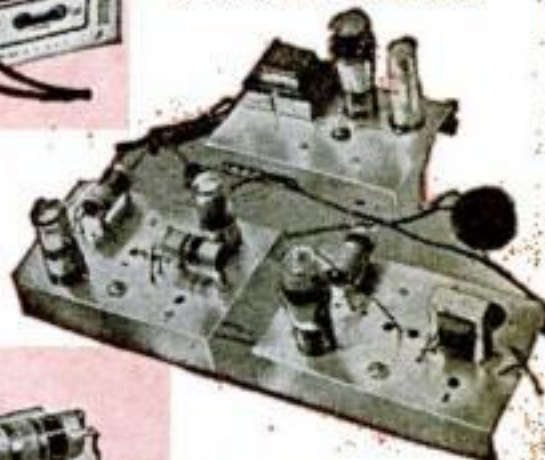
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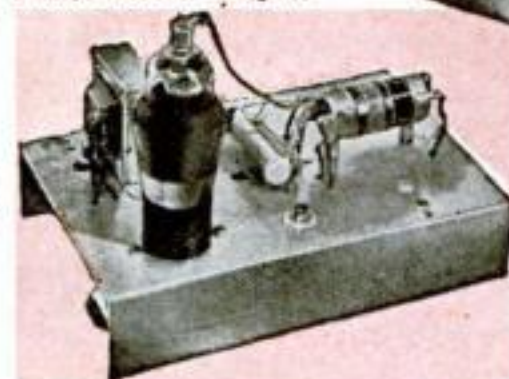
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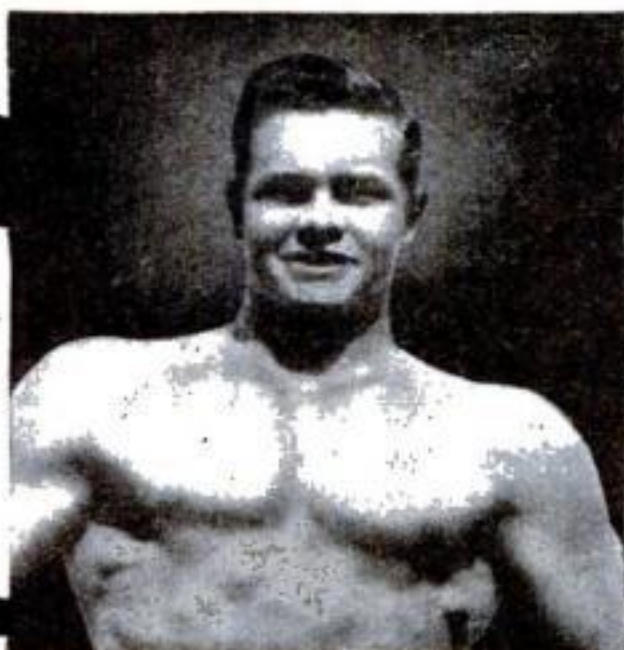
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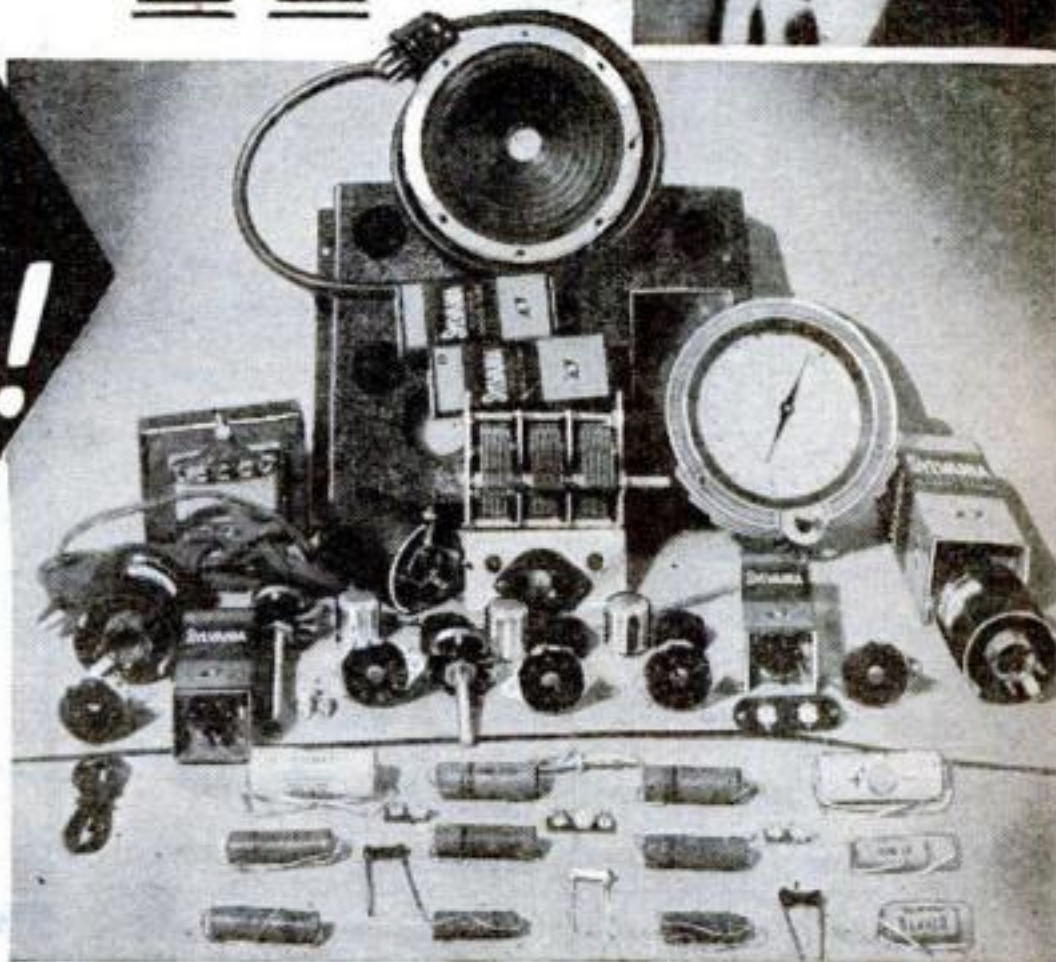
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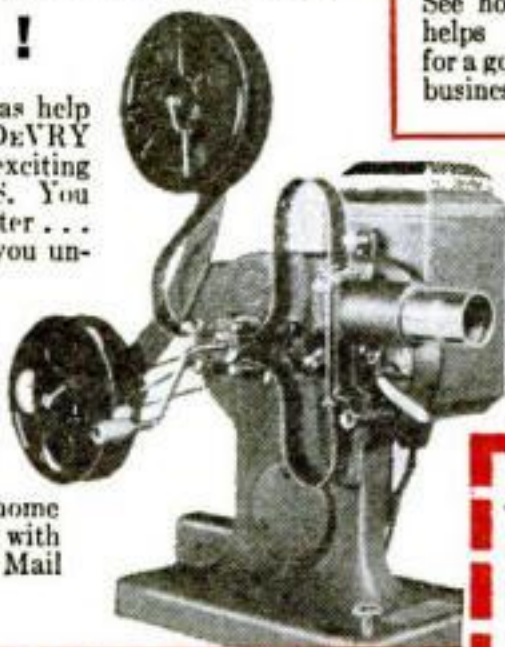
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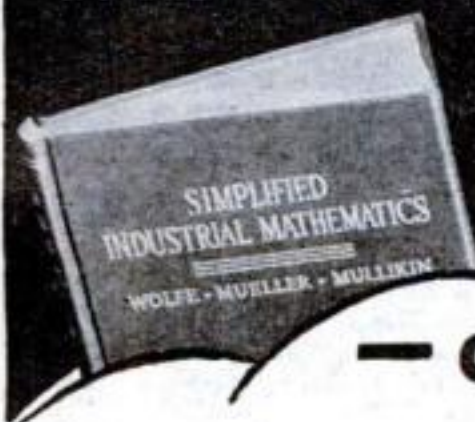


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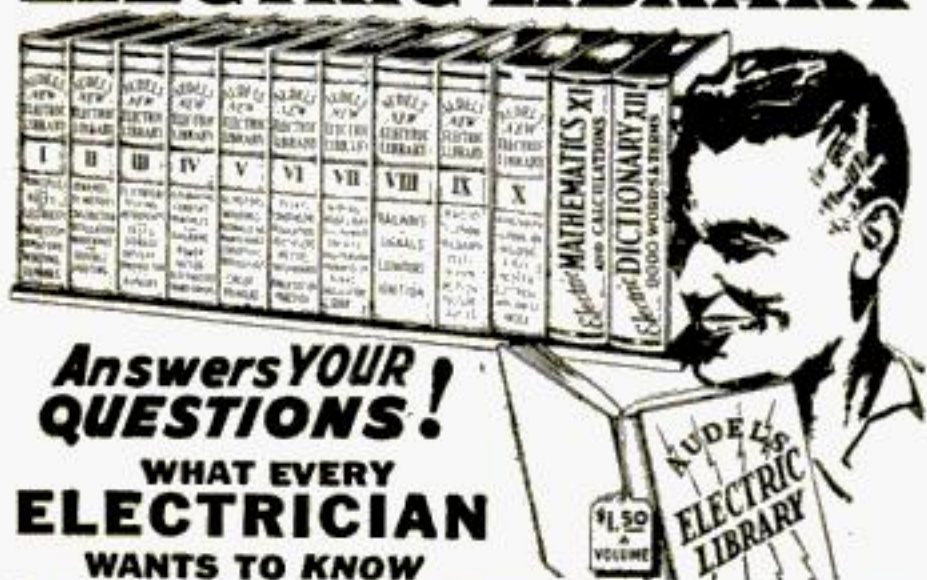
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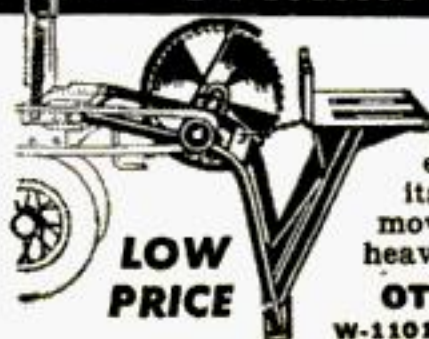
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Readers Say:

Commander Pays Tribute to Photographer Harold Kulick

It is with deep regret that I have been informed of the death of Mr. Harold W. Kulick, war correspondent and photographer representing POPULAR SCIENCE magazine. Mr. Kulick was killed when an aircraft of this command in which he was flying as a photographer-observer crashed near its home base after returning in a damaged condition from an operational mission over enemy territory. To secure pictorial coverage of B-26 airplanes in action, Mr. Kulick willingly shared the risks of combat crewmen. His courage and devotion to professional duty in face of danger are a tribute to himself and his profession. His loss is felt keenly by all personnel of this command who had come to know him.—Samuel E. Anderson, Brigadier General, USA, Commanding IX Bomber Command.

Readers of this magazine will remember many examples of the high artistic quality of Harold Kulick's work. Associated with writer Hickman Powell on the POPULAR SCIENCE war-front reporting team, he illustrated such outstanding articles as "The Kite That Smashed Berlin" (Mar. '44), "Chasing Echoes on a Destroyer Escort" (April '44), "What It Takes to Be a Thunderbolt Ace" (May '44), "A Fortress Lives to Fight Again" (June '44), and "Fighting at 425 Miles an Hour" (Aug. '44).—Ed.

Bombay Man Suggests a Toughen-up Exercise

IN A recent issue of POPULAR SCIENCE, in the article "Can We Make Our Soldiers Tough Enough?" there are given 12 Army exercises, which, after trying, I liked very much. But still I think that one of India's best exercises, the "Asan," has almost all the properties of these dozen exercises plus one, the breathing exercise, that is better than all the others. This is to be done at sunrise, with the



body facing the sun. I wish to let Americans know about it, so I enclose a diagram showing how it is done.—M. J., Bombay, India.



This model of a P-38, constructed by a reader of P.S.M., features retractable wheels. (Letter below)

body facing the sun. I wish to let Americans know about it, so I enclose a diagram showing how it is done.—M. J., Bombay, India.

Model of P-38 Lightning Has Retractable Wheels

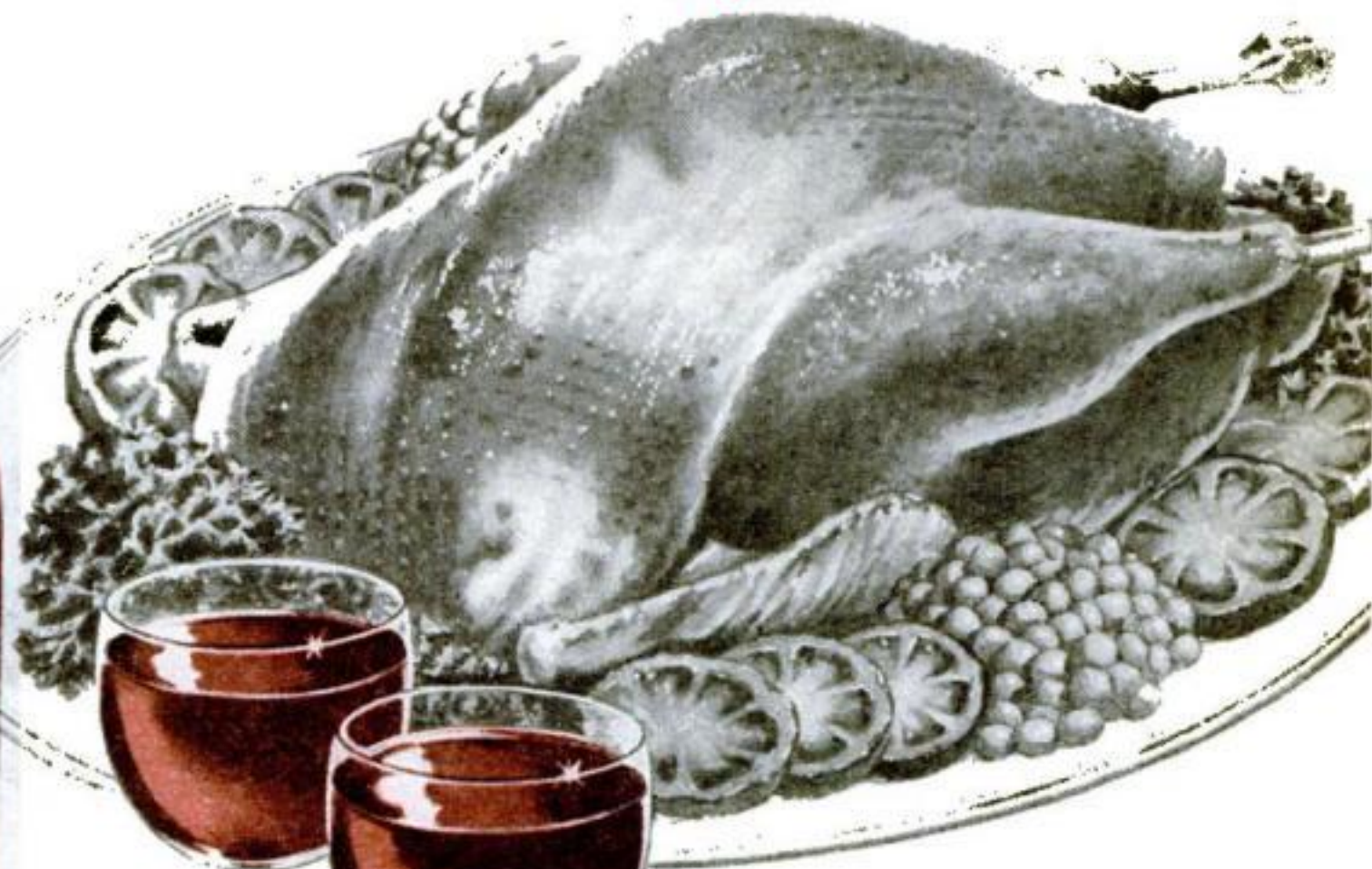
I've read POPULAR SCIENCE for many years and constructed many of the projects contained in its pages. Now I believe I have an idea that you might wish to pass on to others who build from your directions. I've never heard of any solid-model airplane kits being offered anywhere that include retractable wheels. I have built from kits and from scrap wood about the house; and I like to have the models stand up while on exhibition and to be able to hide the wheels when holding the model out of a car window in "flight." I used candy-sucker sticks as the struts.—J. R. L., Pueblo, Colo.

P.S.M. Hoarder Finds a Way to Aid in Paper Drive

If I had been asked to turn in my car for scrap metal, I would have been less shocked than I was when you people suggested that I should give up my old copies of P.S.M. for the waste-paper drive. I ranted around home about it, pointing out to my long-suffering wife that the back numbers constituted the best reference library a man could own. I simply couldn't let them go. Then the brains of the family came across with the swellest idea since the invention of the zipper. She said, "Why don't you go through all the issues, and if there are any articles or pictures you particularly want to save, just cut them out? It won't hurt the old-paper value of what's left." Well, I did just that—and presented a tidy poundage of paper to the salvage drive.—D. S. W., Memphis, Tenn.

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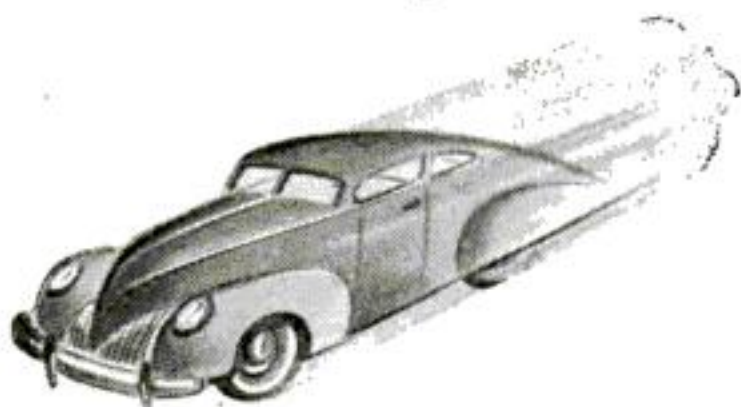
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You Might Try This When You're Lost on a Lonely Island

PERHAPS some of your readers would like to tackle this one. A group of shipwrecked sailors, wishing to know the approximate latitude of their island, constructed a pendulum from the anchors and cable of their lifeboat, and hung it from the top of a tree. Then the pendulum was set in motion. At the end of one hour, the pendulum appeared to have rotated three degrees in a counterclockwise direction. Were they north or south of the equator, and what was their approximate latitude? As their navigator possessed a chart, he could figure their location.—C. E. M., Lorain, Ohio.

This is a variation of the celebrated Foucault pendulum experiment. The apparent rotation of the pendulum's plane of swing would be counterclockwise, as required, in the southern hemisphere. Applying the formula found on page 439 of "Physics for College Students," the latitude would be approximately 11 degrees south, or about the latitude of the Solomon Islands.—Ed.



Modern Abolitionist Wants New Term for Horsepower

I AM writing this letter in the hope that it may help publicize an idea of mine. I wish to form the S.A.T.H.S.B.T., or the Society for the Abolition of the Term "Horsepower" and Substitution of a Better Term. "Horsepower" in these days of high speeds and high altitudes seems to me to have been outmoded. Years ago, when the first automobiles raced along at the incredible speed of 12 to 15 m.p.h., such a term as "horsepower" was suitable, for a team of horses, if bred and trained right, could easily pull a carriage at such a speed for a short time. But on Dec. 17, 1903, this term received its first blow, for on that day the Wright brothers flew the first heavier-than-air machine successfully; and what horse could have pulled it fast enough and long enough to make that possible? Who will help promote the S.A.T.H.S.B.T.?—W. B. R., Atlanta, Texas.

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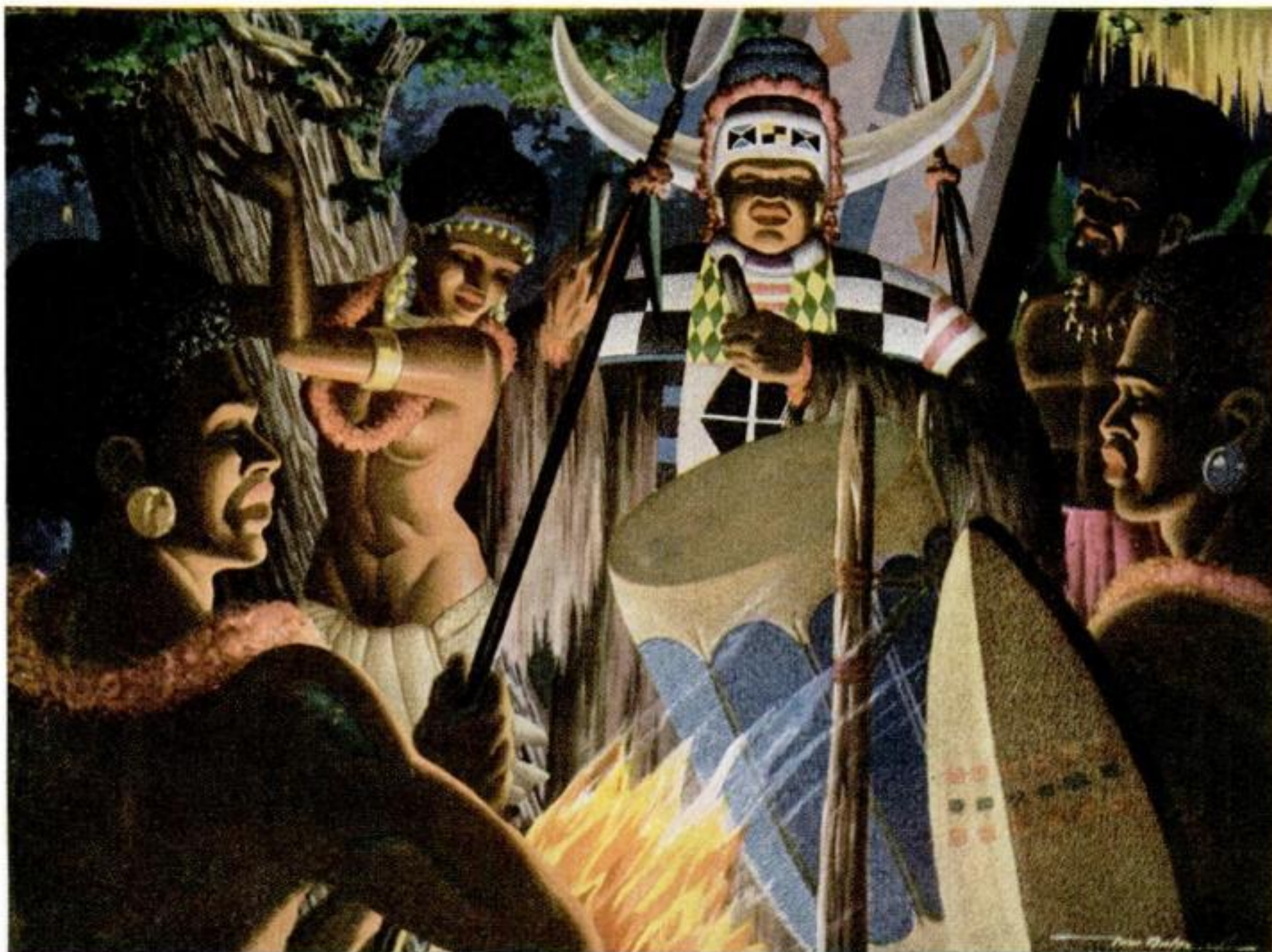
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Readers Say:

Ball Going Up Doesn't (Does) Stop Before Coming Down

I WOULD like to answer J.M.K. in Readers Say. The ball thrown up does not rest momentarily. That is an impossibility. Any object thrown into space always describes a parabola. At its highest point, the object changes direction, and its instantaneous velocity at that moment is zero. Problems of this nature are treated in detail in physics and calculus.—S. E., Linden, N. J.

IN ANSWER to J.M.K., the answer is evidently yes. The flaw in his reasoning was that a body stops or comes to a rest when all the concurrent forces on it total zero. The condition comes about when the vector force, representing gravity, has increased to such a point that it exactly equals the decreasing vector quantity representing the thrust from the ground. Though this condition occurs for an infinitesimal part of a second, nevertheless the body has entered a state of rest, i.e., equilibrium, and can correctly be considered to have stopped.—H. D. B., Great Neck, N. Y.

Happy Ending to a Story with Two Characters

I AM just dropping a line in to say how much I enjoy POPULAR SCIENCE. When the first of the month comes around, I follow the postman all over half the block begging him to tell me whether or not he has my P.S.M. before he gets to my house. Today I begged him to tell me if he had it and he finally gave it to me. I am just 12 years old, but I look forward to every issue. I sure do enjoy those articles about airplanes, and also Readers Say. Could you possibly publish something about what the Signal Corps is doing at Fort Monmouth, N. J., as my father is in the Army there? I hope you will print this, as I would like to show it to my postman. How about a cartoon of me looking over his shoulder?—C. D. L., Richmond, Va.

Here you are.—Ed.



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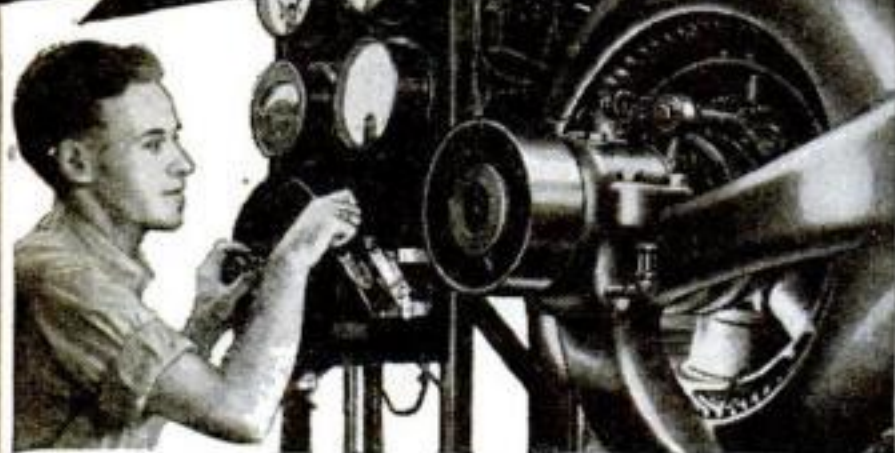
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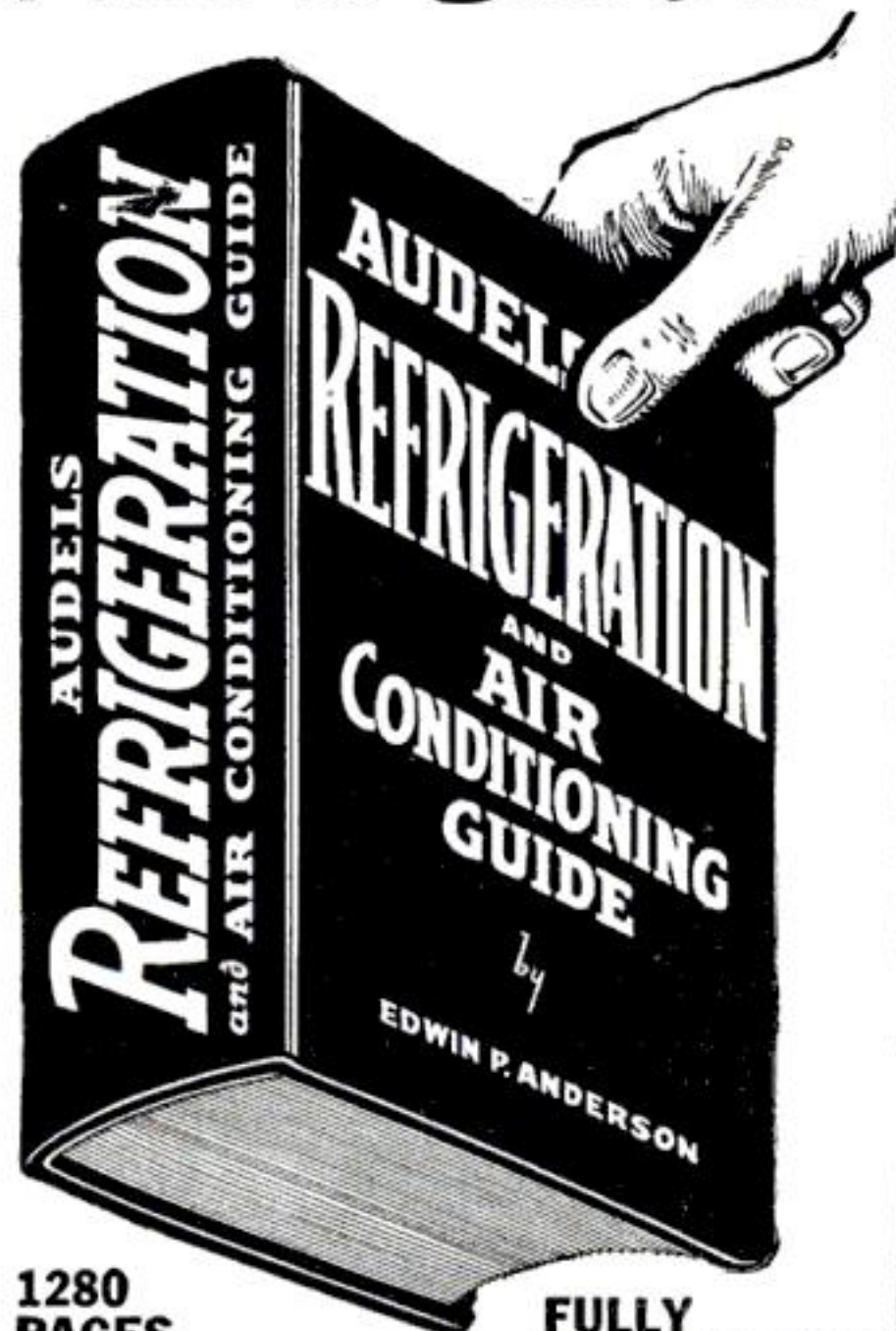
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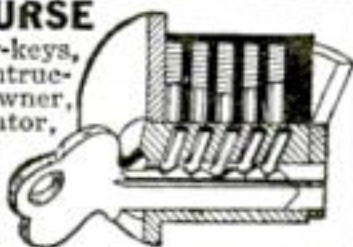
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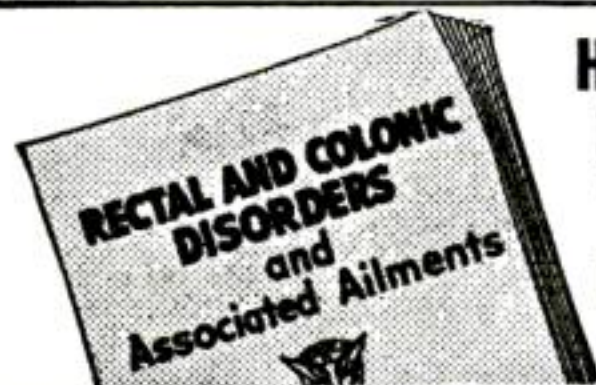
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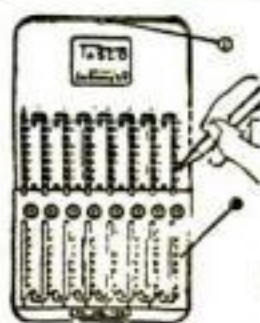
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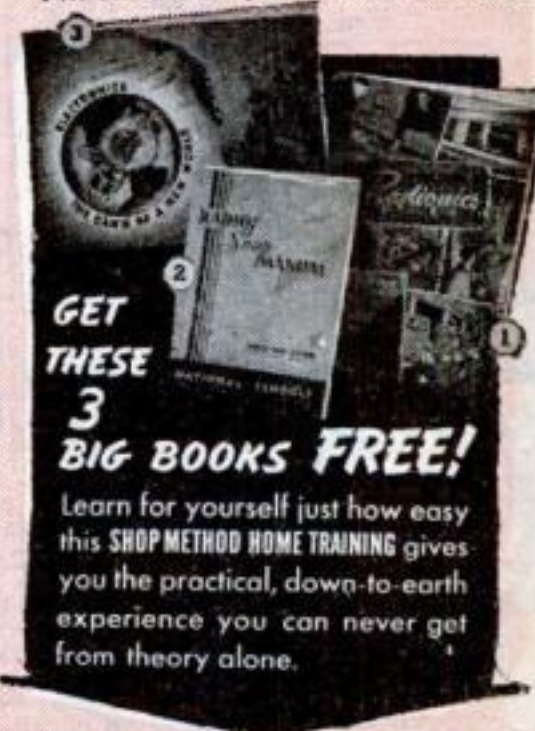
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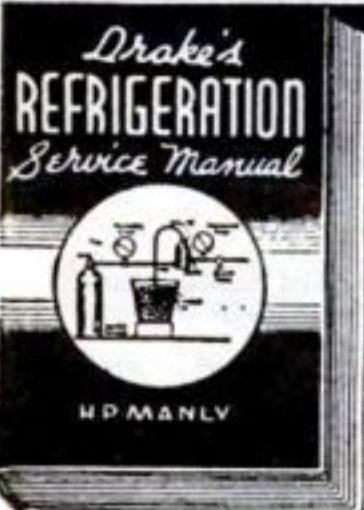
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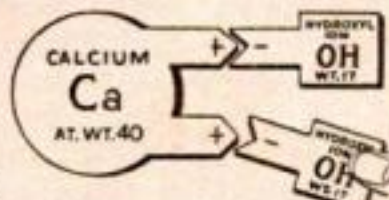
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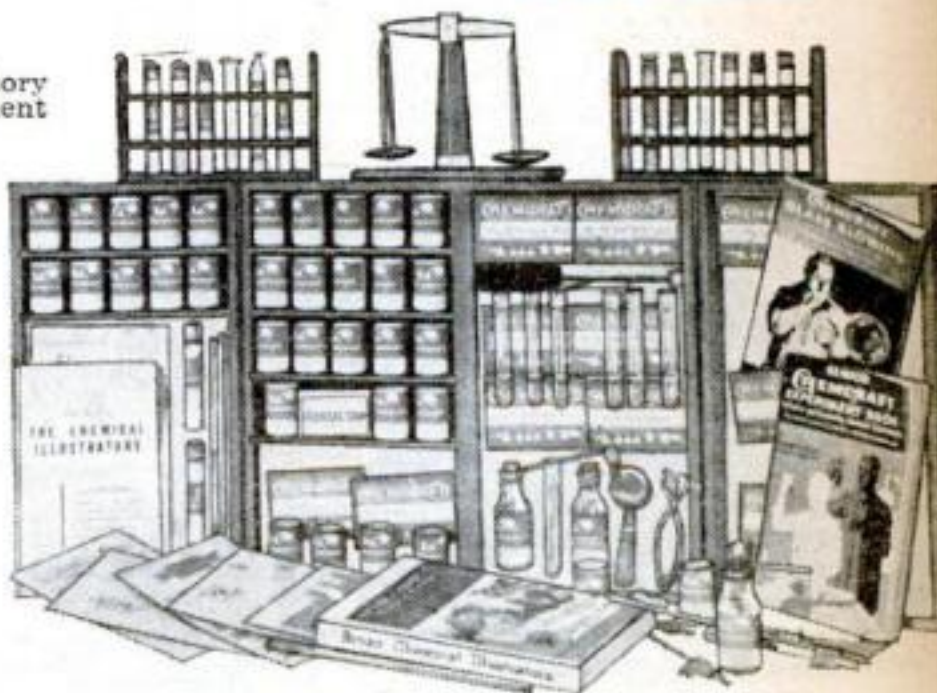
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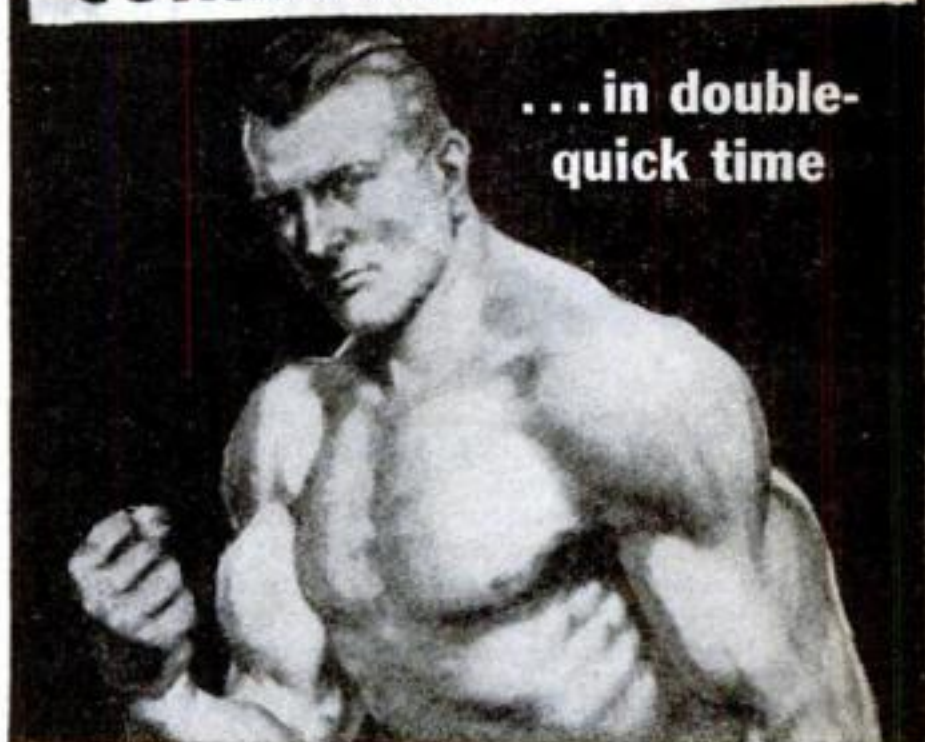
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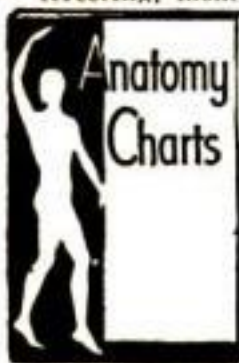
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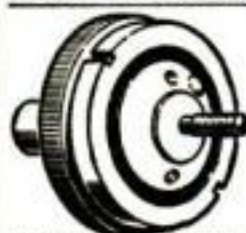
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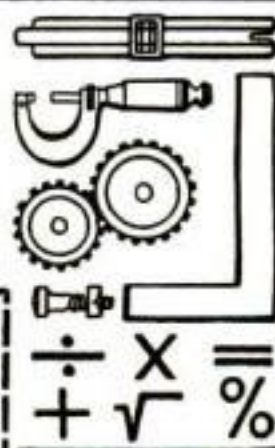
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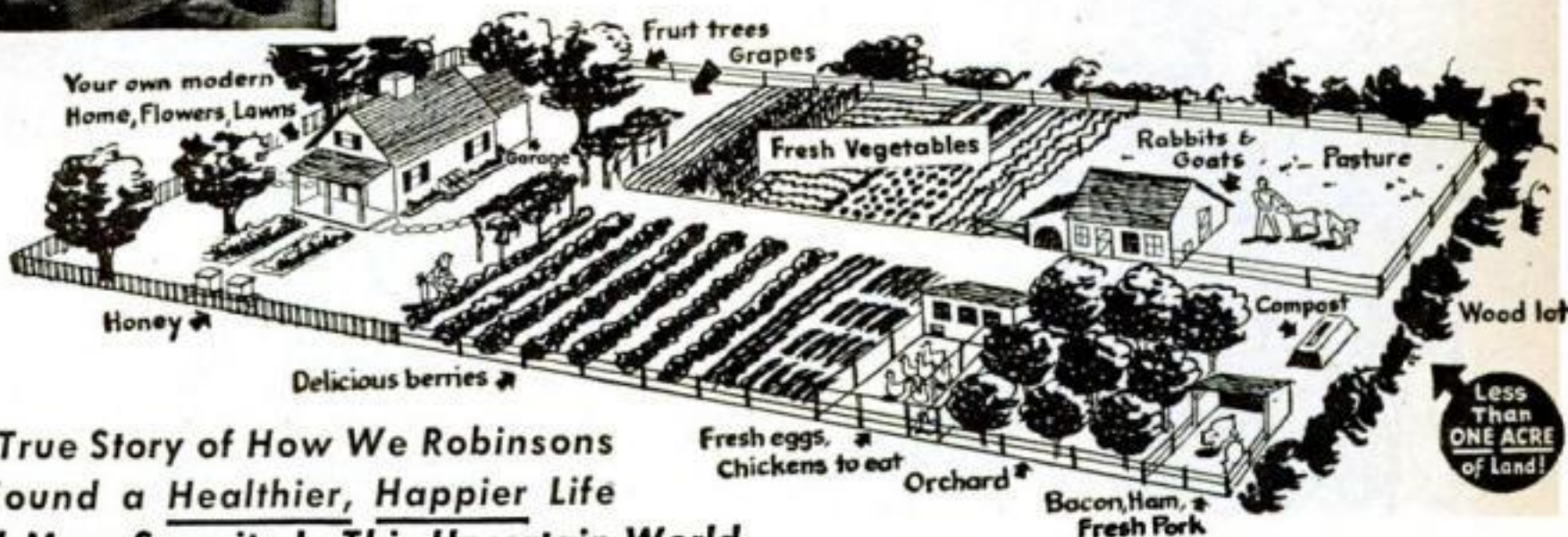
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HOW YOU CAN DO IT, TOO!

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IF YOU FOLLOW OUR PLAN HERE'S HOW YOU'LL BE SITUATED

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OUR PLAN IS \$1.00

We'll send you our Plan if you write us and send one dollar. We wish we didn't have to charge anything for our Plan—but it does cost money to get things printed, mailed, etc.

Anyway, we've kept the price just as low as we possibly could.



Mrs. Robinson and our son, Jack. The home-raised goose I'm holding weighed 10 1/4 lbs. at 10 weeks of age. All the food it ate was stale bread and grass growing around our place.

If, after you look over the Plan, you aren't pleased and delighted we'll gladly send your money back.

A GRAND WAY TO LIVE!

If You Have a Full-Time Job:

You can easily work out the "Have-More" Plan in an hour or so of spare time a day. You can have a beautiful little place near your job. (There are hundreds of such places near every city.) If you work long hours and don't have time to do the whole Plan at present, you can do part of it in as little as 15 to 30 minutes a day. Even so you can have all the health, happiness and security of this kind of living. You can have a fine garden, beautiful flowers—get your fruit trees, berries, asparagus and rhubarb started, perhaps even have a few chickens.

This way of living is especially good for children. You can get your place all paid for and have that wonderful sense of security and independence knowing that you and your family have your place to fall back on—that you could get by with very little cash income if you ever had to.

If You Have a Part-Time Job:

If you work short hours, such as 40 hours a week or less, you can get all the more benefit out of the Plan. Perhaps in your work you have several days a week free or perhaps several weeks or months a year free. If you have a place like ours you can invest that free time in your own future security.

If You Are Planning to Retire:

Or if you are already retired, you can see that this Plan is a very practical way to stretch your retirement income and to help keep yourself in better health. This way, if you are going to receive Social Security benefits, or with just a small pension or annuity, you can look forward to many years of happiness and security. We've heard from lots of folks from Vermont to California who are doing just this right now!

If Your Income Is Limited:

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Honestly, this Plan can be the way for you to have more of the really worthwhile things in life—if you'll just turn loose and get started! So sit down this minute and write me. Just put a dollar bill in an envelope with your name and address.

Right now is not only a good time to get started, it's an excellent time to make your plans for the future.

Yours for "a little land and a lot of living."

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OUR PLAN TELLS HOW

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How to rent or buy the right kind, near your job, for as low as \$30, \$40 a month. (If you don't already have a place.)

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How to choose and care for them so that they will bear years sooner.

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Your investment back each year—and they are awful good eating!

LOTS MORE

there isn't room to tell all about here. It's how you can have more—more security, better food, better rest, more fun, more of just about everything that makes life worth living!

If You Already Have a Place

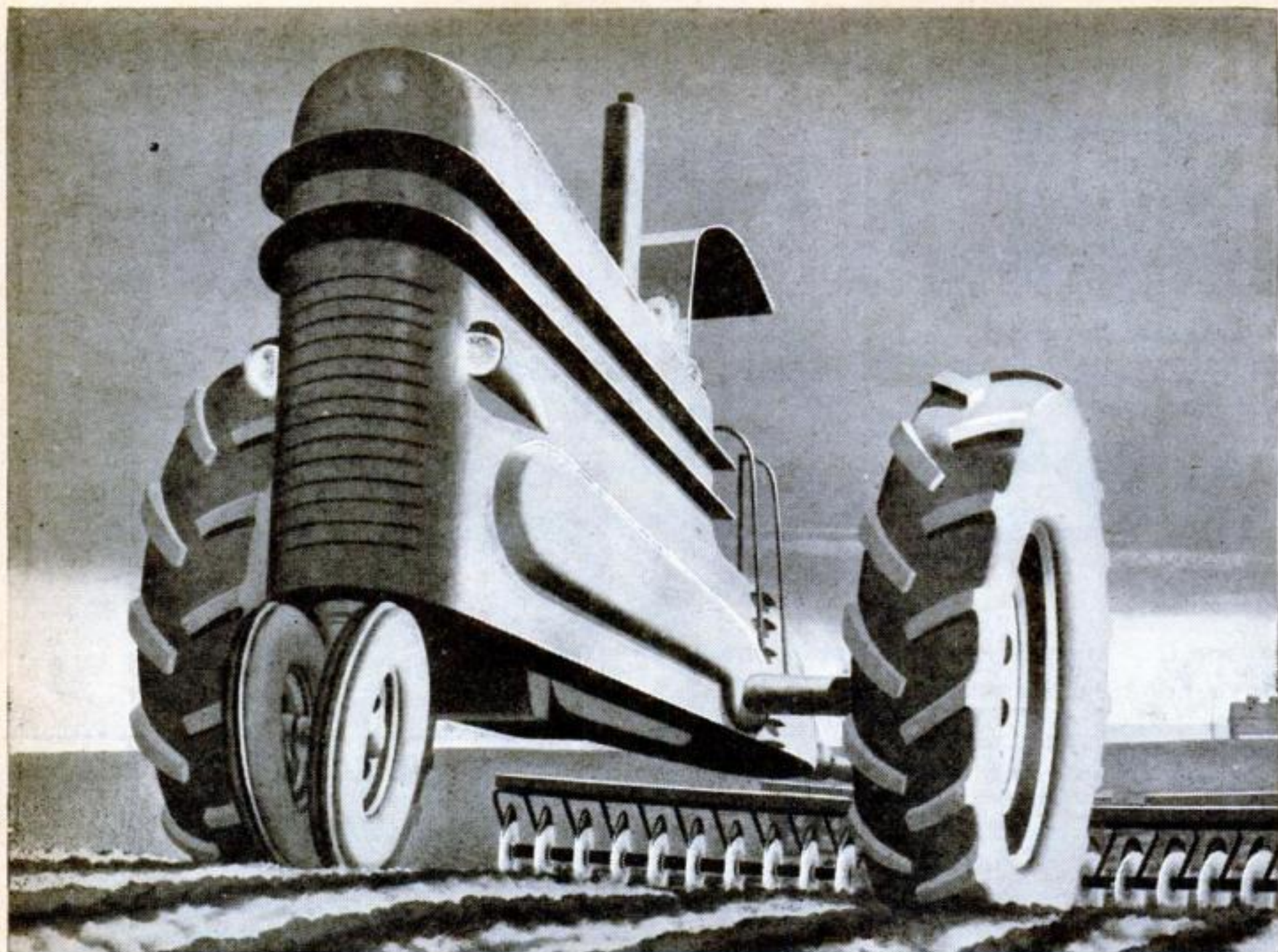
Maybe you'd like to "compare notes" with us. Our Plan is laid out step-by-step, subject-by-subject, with lots of actual photographs of our place, diagrams, charts, tables, drawings. It shows how we do things the easiest, latest, most practical and scientific ways we can find. Who knows, maybe we can show you some short cuts, new methods, help you get better results. Just one new, good idea would be worth a lot more than the price of the whole Plan—and you'll have a lot of fun comparing your methods with the way we do things?

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If you do, just put a dollar bill or dollar money order (if bank check, \$1.05) in an envelope with your name and address and turn it over to Uncle Sam's mailman. We'll send your copy of our Plan by return mail. If for any reason you aren't pleased with it, let us know and we'll refund your money without delay and without question. Address:

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In this typical "church" of a fake medium, conceived by our artist, incense candles and cheap, colored prints of Christ are used to create a religious atmosphere. A certificate, prominently displayed, testifies to the medium's admission to the ministry of a spiritualistic cult. The customary "donation" is 50 cents

By **HELEN WORDEN**

THIS is a boom time for spirit crooks, mind readers, and phony dealers in the occult. Their industry for the past few years has victimized millions for a "take" that has been estimated at as high as \$200,000,000 a year. Thousands of men and women calling themselves mediums are operating in the United States today. No city is free of the activities of these most contemptible confidence crooks, for the most part preying on those bereaved by the war, or touched by its ravages.

The war has given these soul chisellers a fertile field in families that have suffered loss, or fear the loss, of loved ones. In the victims is the hope of life after death and a desire for demonstration of the supernatural. And it's a sorry rooking they get

EXPOSING Tricks of the Fake Mediums

"SPIRIT WRITING"



"Spirit writing" is the medium's stock in trade. Using some trick to read the supposedly concealed question her visitor has written, she numbers both sides of two slates, one to four, with chalk

With her victim already "holding the bag," she inserts the slates and chalk, the latter so that the "spirit" will have something with which to write the answer. In handling the slates, she holds her thumb on slate "four"

—their most sacred feelings exploited by confidence men and women, usually for small sums but sometimes for fortunes, once they have been "built up" and have fallen for the racket. This is frequently done in the name of religion.

As a newspaper reporter, I have come in contact with the tragic results in the wake of these phonies—suicide, disgrace, and misery to those who have listened to the spirit crooks only to learn later that they have been duped. By personal investigation I have seen their barefaced trickery in operation.

At the outset, let me say, there are many sincere spiritualists who believe in life after death and are constantly seeking proof. But these do not practice trickery for gain or give advice on future conduct, business deals, and romances. Those rackets are for racketeers.

My investigations were made in a party of four, which included Julien J. Proskauer, famous magician, a former president of the Society of American Magicians and now public-relations director of the Magicians Guild, the professional magicians' organization. He is internationally known for his writings on spirit fakery, and especially for his book entitled "Spook Crooks!" Also in the party was Rose Mackenberg, special investigator of spirit crooks for the late Harry Houdini.

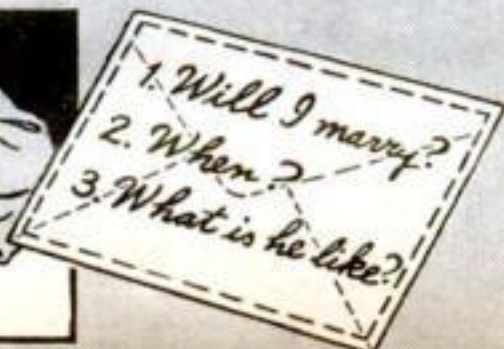
We selected two addresses. The

Photographs by
WILLIAM W. MORRIS
and ROBERT F. SMITH

HOW FAKERS READ MESSAGES SEALED IN ENVELOPES



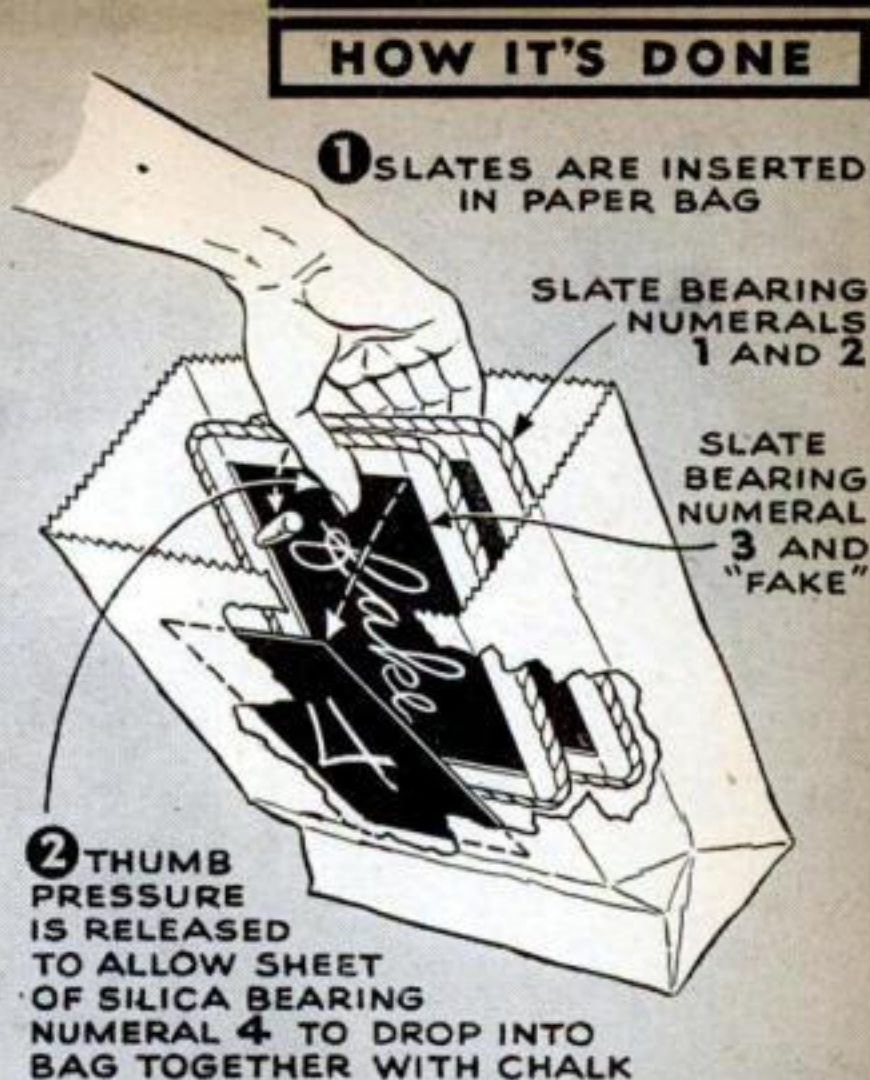
One of the simplest ruses employed by fake mediums to demonstrate their "psychic" powers is what is known to the trade as the "alcohol-cushion" trick. Seated at a table on which lies a cushion, this medium has concealed in her left sleeve a rubber alcohol-spray bulb. With her right hand she selects one of the envelopes in which her victims have sealed their written questions. Placing the envelope on the cushion, she presses her left arm on the table, sprays the envelope, and thus makes it transparent enough for the enclosed writing to be read. Incense kills alcohol odor, dim lights hide any slips



POPULAR SCIENCE



Removing slates, she shows her visitor how, instead of the numeral four, there now appears the spirit's answer. Indicated here by the word "fake," answer is written by confederate before slates are put in bag



Actually what has been accomplished is nothing more than a very elementary version of the old false-bottom trick. The silica sheet is left in the bag; but, being extremely light, it is undetected by the victim

first was in an unprepossessing tenement building. There we were to visit a medium whom we shall call Laura, although that is not her real name. The hall was dark and the steps steep. At the head of the stair were two signs. One directed the way

to a musical-instrument repairman. The other read, "Rev. Laura ———. Turn to your left." Miss Mackenberg and I walked ahead.

An attendant waited at the door. In one hand she held a basket for the contribution;

Magicians' Supply House Sells Information on How It's Done

Below are condensed descriptions of a few items taken from a catalogue of Nelson Enterprises, Columbus, Ohio, which sells a complete line of equipment for magical and entertainment purposes only.



ENTRANCED MEDIUM TRUMPET SEANCE.

How the medium, securely bound, enters a trance, calls spirit guides to possess his material body, then through a trumpet gives names of spectators, messages, and answers to questions. Apparatus with instructions—\$17.50.

IMPROVED MEDIUM'S MIRACLE TABLE.

Last word in mechanical devices for private reading work. The performer has instant knowledge of contents of paper held in the spectator's hand. All the performer needs to do is to open the drawer and the duplicate of the writing is automatically placed in front of him, properly shielded from the spectator's eyes. Price, \$75.



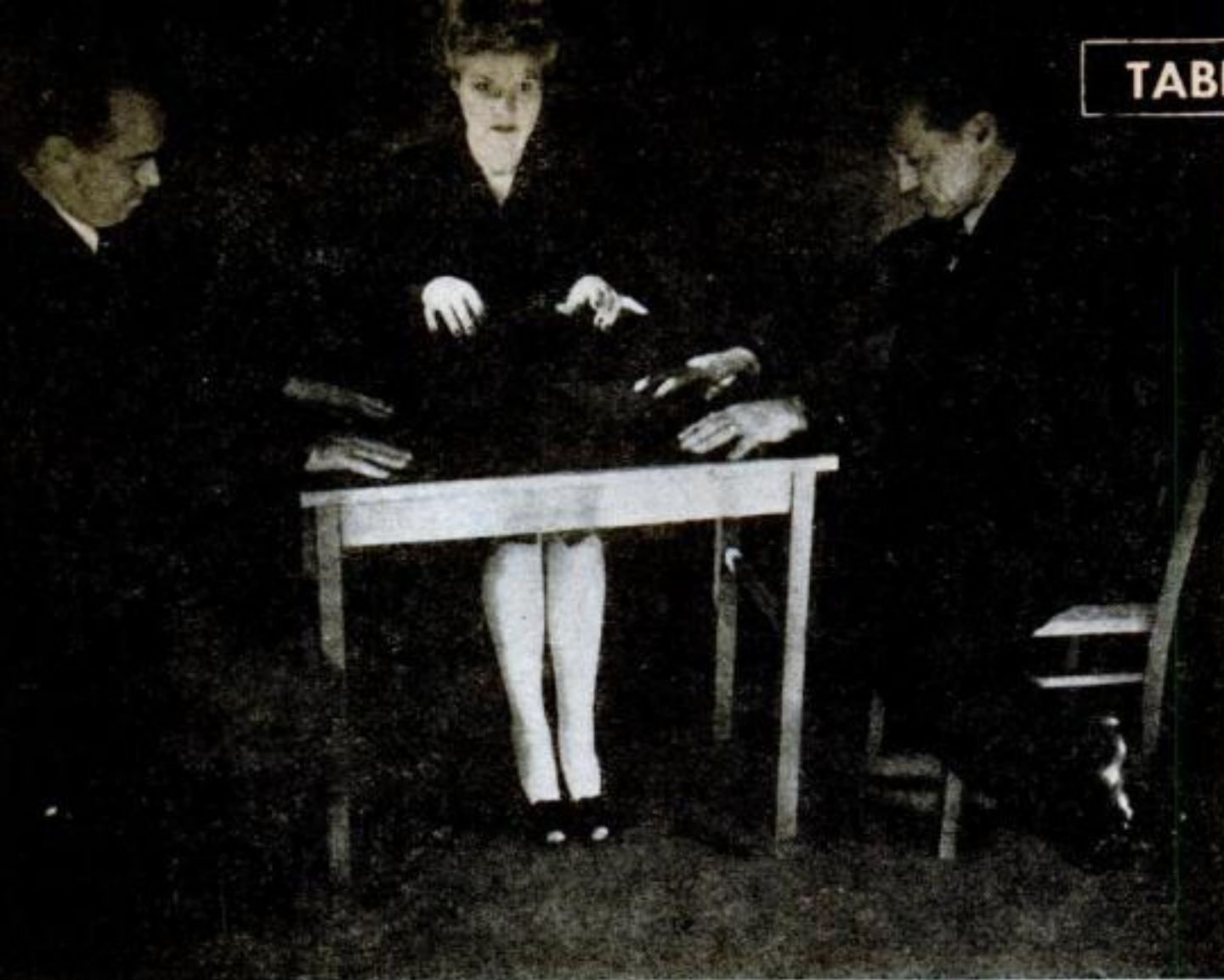
THE MEDIUM'S TEXTBOOK. The medium takes the platform, opens her Bible, reads a few paragraphs therefrom, and answers sealed billets. The Bible, which is a Bible in appearance only, permits her to learn instantly the contents of each envelope the minute she places it on the open pages of the book. No chemicals. Leatheroid cover, gold-stamped, with red edges. A master effect. The price, complete, is \$20.

"CONFESSIONS OF A MEDIUM."

A book of mediums', psychics', and healers' certificates, showing how they get their certificates, which make them immune from police interference. Tells how people enter the psychic field, how they conduct their business for profit, how simple it is for mediums to give real "knock-out" facts without preparation, writing, or apparatus of any kind. A complete explanation of three of the cleverest billet and private reading tests ever devised. Sold with the distinct understanding that any information derived will be used for legitimate purposes only. Price, \$10.



TABLE "LEVITATION"



Tilting or raising a table is another of the more popular hoaxes used by fakers to bilk the credulous. In this "levitation demonstration," in which six or eight people ordinarily would be seated around the table, Julien J. Proskauer (left) and Theodore Hardeen (right), both former presidents of the Society of American Magicians, pose as a medium's secret assistants. Wearing wrist bands fitted with metal hooks (below), they, like the real victims, put their fingertips on the table, being sure, however, to hook the metal pieces under the table's edge. When the medium gives the magic signal, they raise their hands and, miraculously enough, the table also rises into the air with all hands "aboard"

in the other, a box for the questions. Beside her, on a long table, were stacks of small paper slips, cheap, thin envelopes, and pencils. We were told to write our question or questions on a slip of paper, seal the paper in an envelope, write our initials on the envelope, and drop it in the box.

Mr. Proskauer placed a five-dollar bill in the contribution basket. The attendant put down her basket and the box, picked up the bill, and handed him back two fifty-cent pieces and four one-dollar bills. He then dropped two dollars in the basket for the four of us. This 50 cents apiece was not required of us as a "fee"; it was merely "accepted" as the customary "donation."

Next we entered the dimly lighted front room, which seats about 60. This is the "church." On the walls were cheap colored prints of Christ at prayer, and a certificate showing that Laura ——— has been admitted to the ministry of a spiritualist group.

All but five seats were filled. Laura, a thin, worried-looking woman, smartly dressed in a dark gown with long sleeves, sat at a table at the front of the room. Our seats were in the first and second rows. Later, Mr. Proskauer said they were the best we could have had for observing Laura's specialty, the alcohol-cushion trick.

On her left stood what appeared to be a small cushion, perhaps a pincushion, on which she casually rested her right hand from time to time. On her right was a box similar to the one the attendant had been holding at the entrance.

As we took our places, the attendant came in, placed the box of collected questions on the table, and carried away the



other box for the questions of later arrivals.

The medium reached for one of the envelopes, held it a moment as if in meditation, and rested it on the cushion as she intoned:

"And this voice which came from heaven we heard, when we were with him on the holy mount. The second epistle of Peter, chapter one, verse 18."

She paused a moment; her eyes appeared closed, downcast.

"L. C. D.," she called, "you are troubled. Don't worry. Harry is always at your side. Let Mary go her way. Right will triumph. Be still."

A middle-aged woman, dressed in plain but good clothes, nodded happily. "Thank you," she said and walked out. Immediately another seeker for word from the "spirit world" took her chair, coming in from the

crowd that waited at the door. Business was good.

It was some time before my questions were reached. I had written three:

"Shall I stay in New York or go back home?"

"Is Charlie happy?"

"Will glasses help my headaches?"

The envelope I had initialed "J. J." for my assumed name "Jennie Jones." A woman in the rear was crying quietly when Laura came to my envelope.

"J. J.," she said, "raise your hand please." I raised my hand. The "pastor" went into her routine, or the "grinds," as it is called professionally.

"I have many things to say and to judge of you; but he that sent me is true; and I speak to the world those things which I have heard of him. St. John, eight, verse 26." After a moment's pause, she singsonged: "There is a man standing at your side. His name begins with C—Ch—Ch—Charlie. He wants to tell you something."

There was a *(Continued on page 213)*



1 The victim writes a question on a piece of paper and signs his name or initials. These questions usually concern love, money, marriage, business, illness, or travel. In war years, many of the questions concern loved ones lost at the battle front

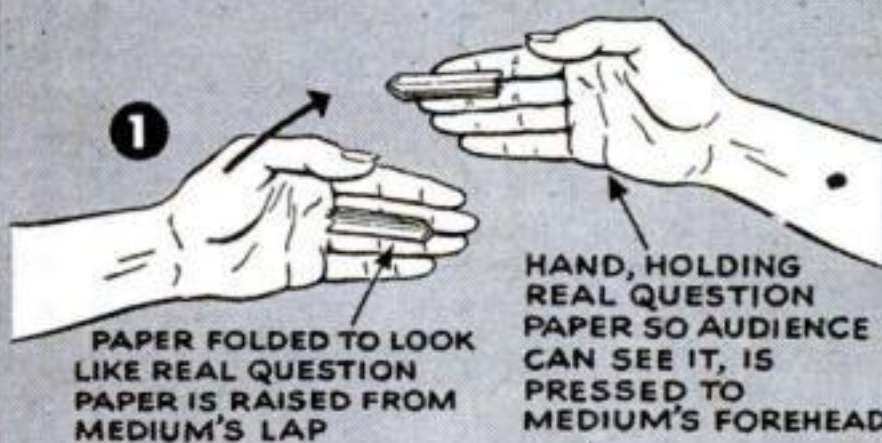


2 The paper is then compactly folded by the victim and handed to the medium, who promptly goes into her hocus-pocus of establishing a contact with the spirits of the "other world." In the jargon of the "spook crooks," this is known as the "grinds"

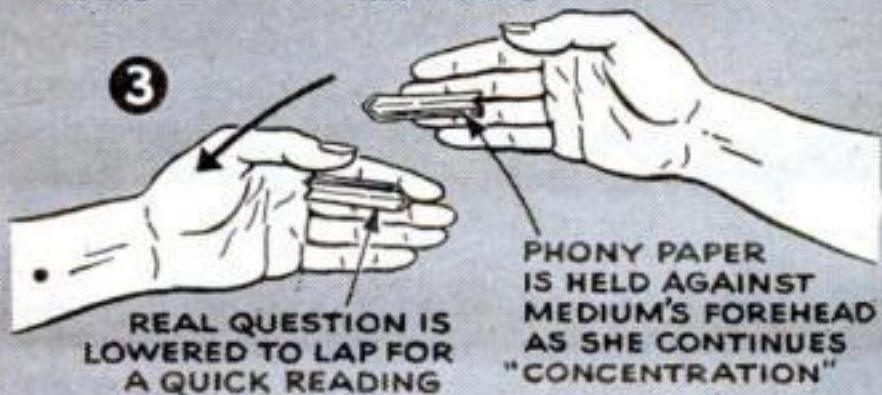
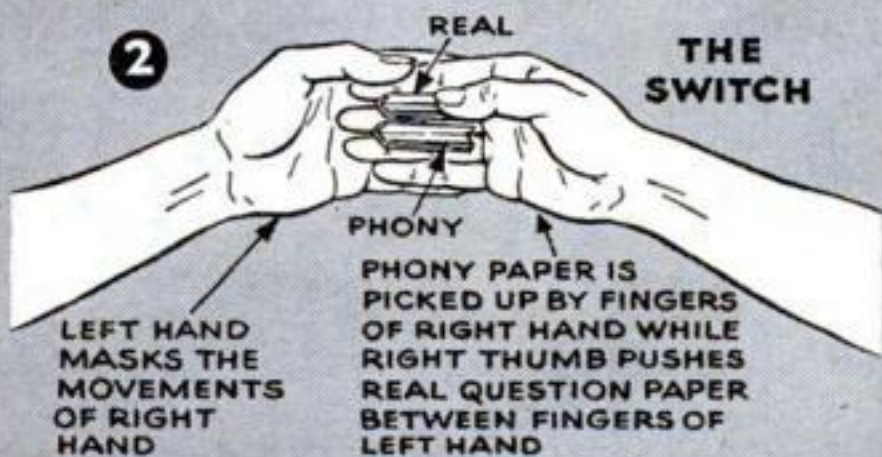


3 Holding the folded paper between her fingers, the medium presses it to her forehead, the better to "absorb" the messages from the distant spirit world. By the simplest sleight-of-hand (diagram at left) she reads the question, gives an answer, returns the paper, and smilingly collects her money

HOW IT'S DONE

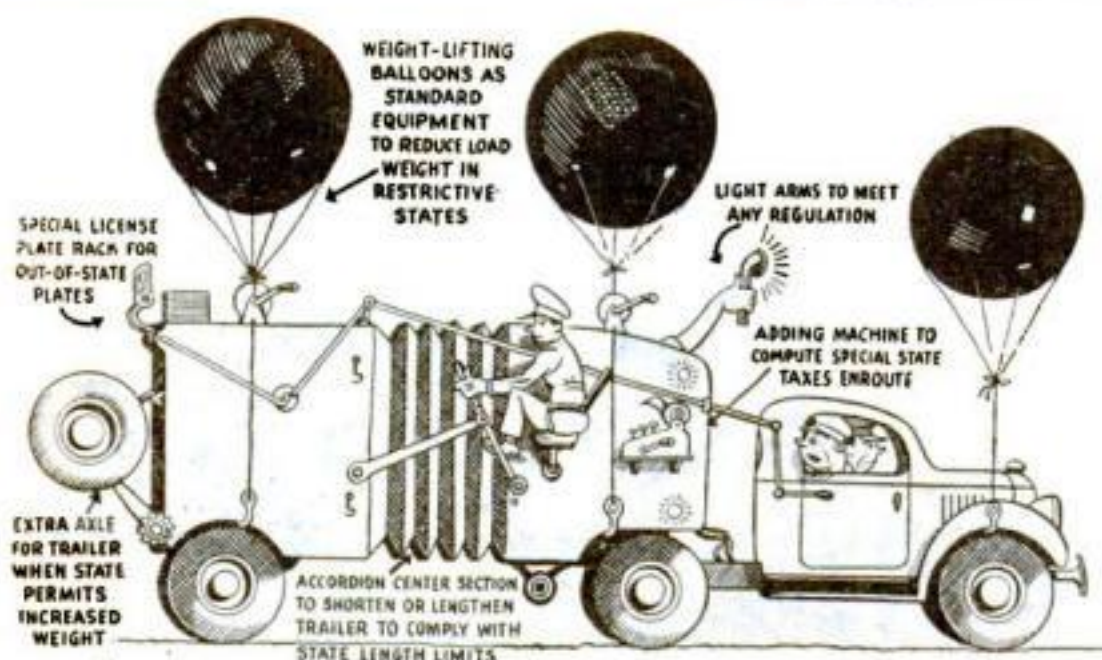


HAND, HOLDING REAL QUESTION PAPER SO AUDIENCE CAN SEE IT, IS PRESSED TO MEDIUM'S FOREHEAD



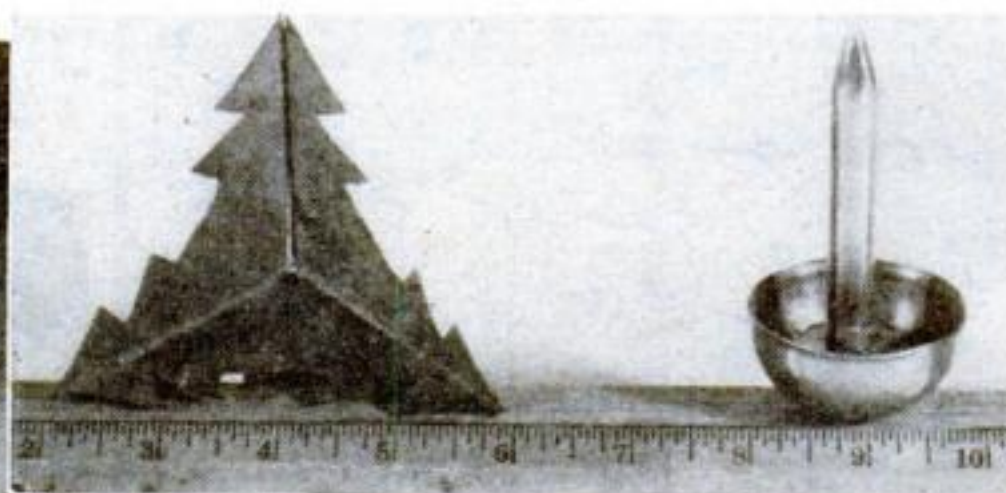
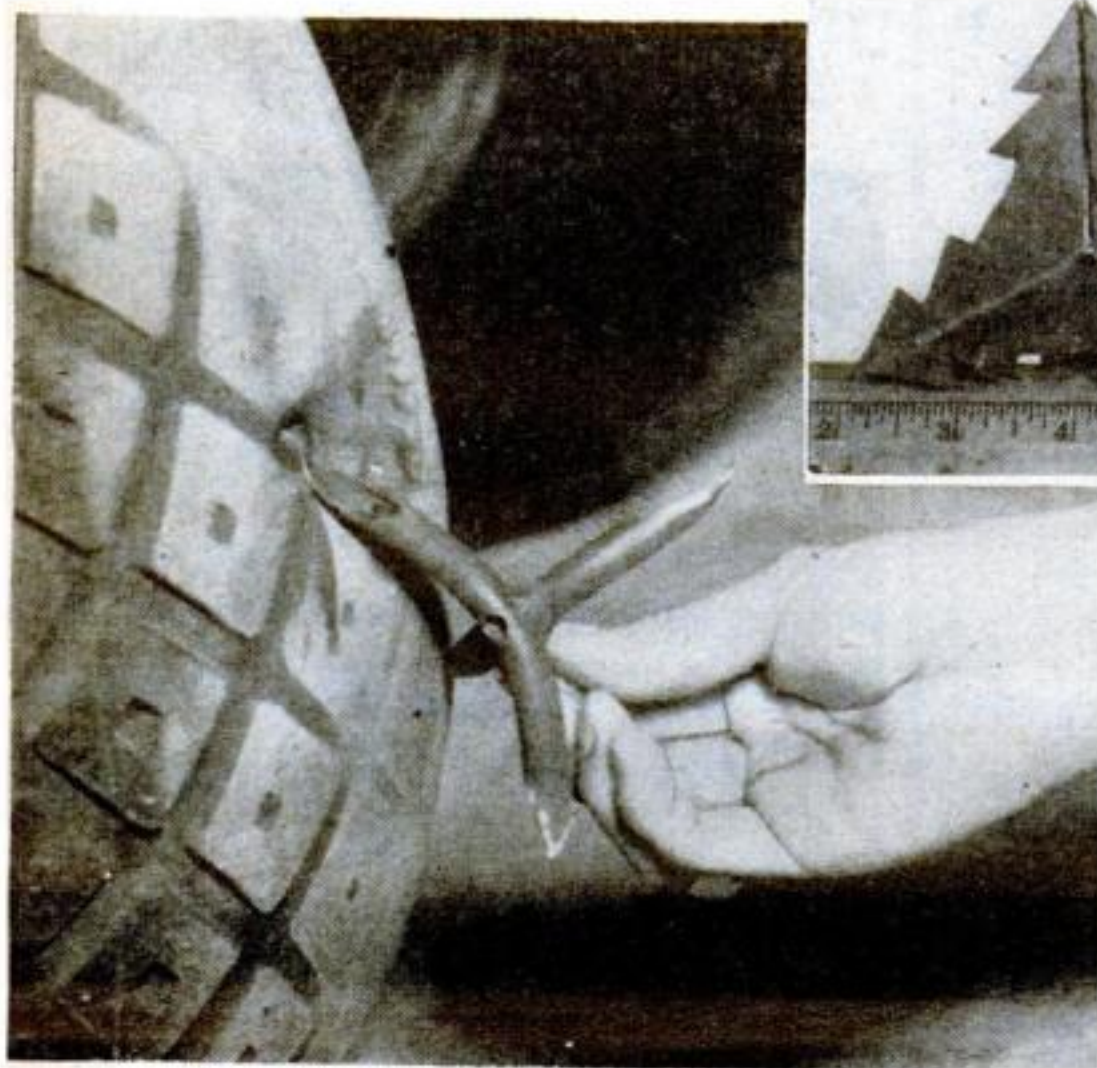
4 SWITCH IS THEN REVERSED; MEDIUM HANDS REAL QUESTION PAPER TO CLIENT, WHILE LEFT HAND DISCARDS PHONY QUESTION PAPER

JUNGLE MORTAR, which throws the 60-mm. projectiles seen beside the gunner, is especially adapted to combat use in South Pacific land areas. An extremely light and portable weapon, it can be carried slung over a soldier's back. The projectile is not fired by dropping it into the barrel, as is usual with mortars; instead, a lanyard-operated trigger sets off a percussion primer located at the center of the tail fins. Using no tripod, the mortar may be positioned against firm earth, tree roots, or any other convenient brace for absorbing the recoil.



The "POSTWAR TRAILER" to fit all State Laws

ALL-STATE TRAILER design has been evolved by harassed engineers of the Fruehauf Trailer Co., Vernon, Calif. If such a vehicle were mechanically possible, it would meet all the conflicting requirements of the various states as to load, length, lights, number of wheels, placing of license plates, etc. Variations in automobile laws are illustrated by the fact that, while in New York trailer length may be 50 feet, in Illinois the maximum allowed is 35 feet.

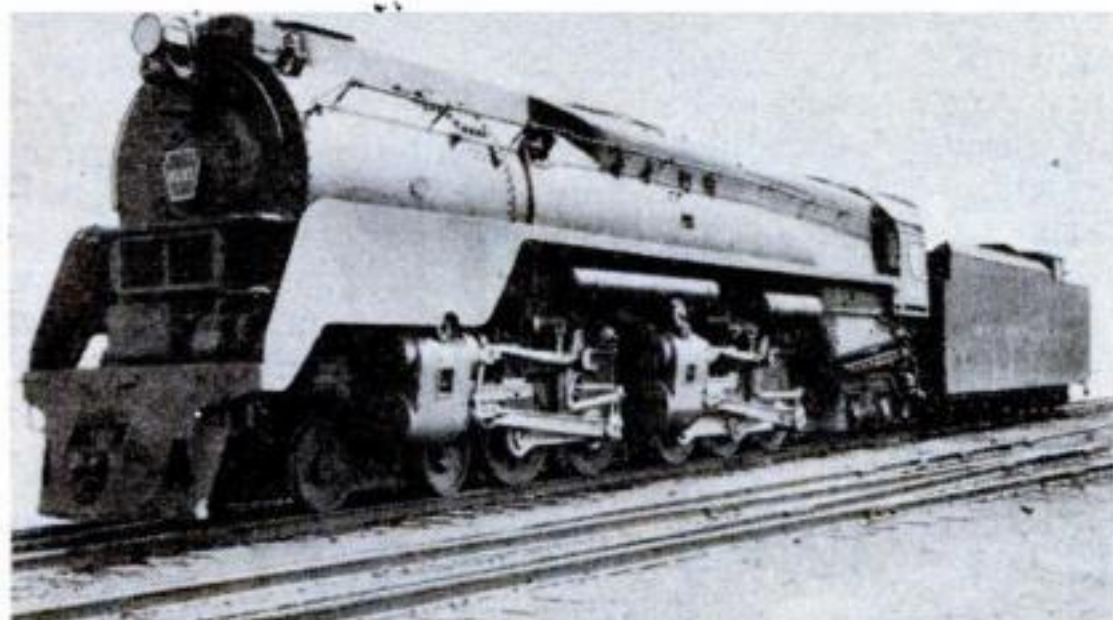


NEW TACK-TICS. Latest device of the AAF for annoying enemy airmen is to sow their airfield runways with puncture-producing barbs. Three types are used: the four-pronged "big boy" (left), the "Christmas tree," and the single barb. Dropped from boxes carried in bomb racks, the barbs always land with a point up to wreck planes taking off or landing. They are also sown on roads ahead of truck columns.

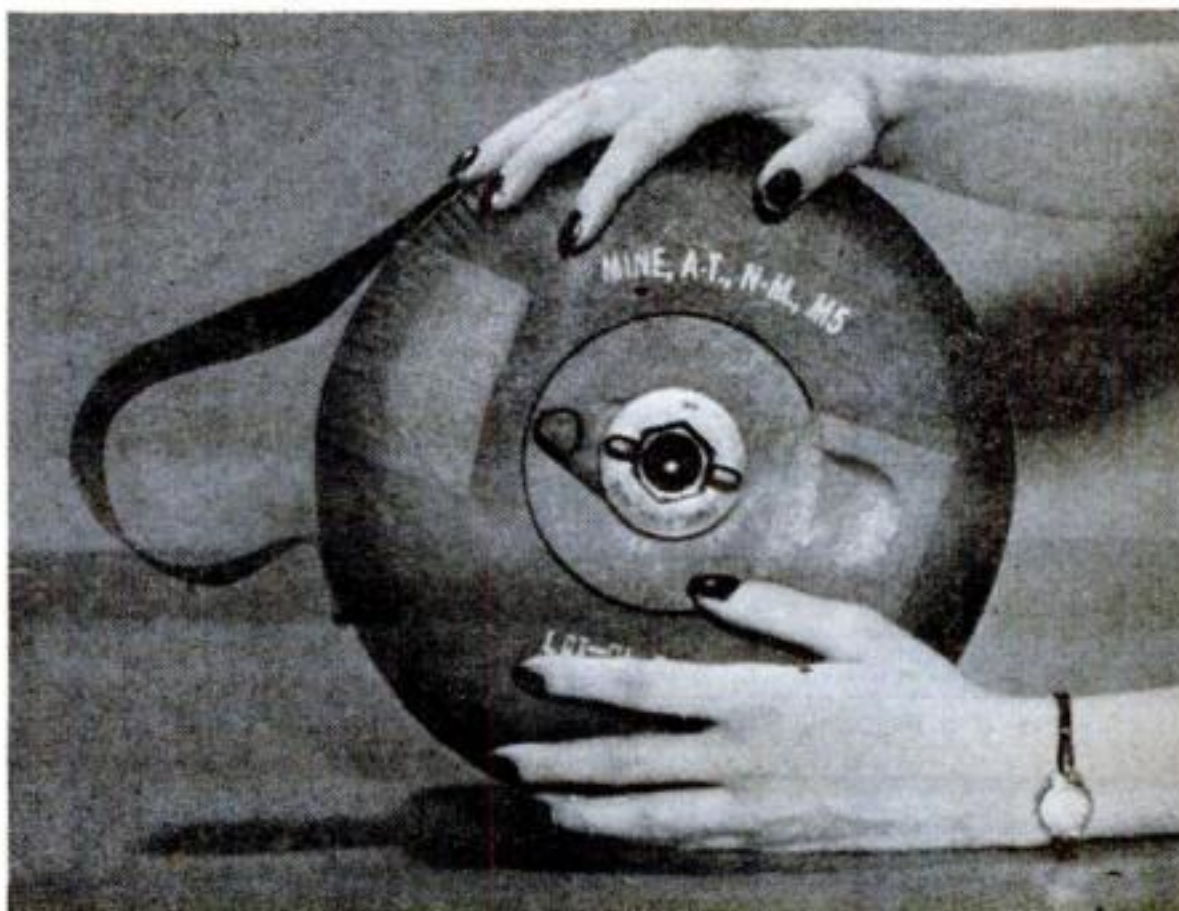
NEW OXYGEN EQUIPMENT, designed to minimize the shortcomings of older types, will enable combat airmen to fly above heights of 40,000 feet without ill effects. They could even live at 50,000 feet for brief periods. Necessary for prevention of anoxia, or oxygen-want, is enough atmospheric or mechanically induced pressure to force air into the flyers' lungs. It is outside air pressure that accomplishes this at altitudes in which man normally lives. The new equipment simply puts oxygen under sufficient pressure to compel its entry into the lungs. The heart of this aid to high flying is a "diluter demand breathing regulator" connected with the oxygen mask. The pilot merely turns a dial as he goes higher.



SMOOTH JOB is a new-type steam locomotive especially designed to pull heavy loads of freight at high speed on The Pennsylvania Railroad. Weighing over a million pounds, and, including its tender, 124 feet seven inches long, the giant can draw a train of 125 loaded cars at more than 50 miles an hour. A double set of cylinders is used, the forward driving two pairs of wheels, the second giving power to another three pairs. High pulling power is maintained up to 70 m.p.h.



GLASS LAND MINES that, because of the absence of metal, the enemy can't locate with magnetic finders or set off with electronic detonators, have been developed by the Army Ordnance Department and engineers of the Owens-Illinois Glass Company, Toledo, Ohio. The mines have been kept a close military secret for many months, and as yet no details of their design or construction have been released. They have proved effective against tanks, trucks, and other vehicles. In addition to glass, plastics are used for some of the internal parts.



Nobody Knows How They Do It, Yet— GLUES NOW PERFORM MIRACLES OF BONDING

By GOLD V. SANDERS

WHEN glue is tough enough and reliable enough to hold fighter planes and bombers together under the terrific stresses of combat, it is time to face the fact that a new era of construction has arrived. We are using glue in place of rivets to build combat planes; in place of bolts, screws, and nails in building PT boats, landing craft, ship timbers, and structural arches. And don't imagine there is anything ersatz about all this; we are using glue for war equipment for the one reason that it is better.

The science of chemistry produced these miracles in bonding, and the urgency of war brought them into a myriad of vital uses al-

most overnight. The employment of these new glues in equipment for war is staggering in extent, and the promise for new civilian uses is one of the brightest of postwar prospects.

Glue has stepped boldly out of doors and into entirely new fields, fortified with new

FIRST THE GLUE IS PLACED BETWEEN
THE MATERIALS TO BE JOINED

POWDER MELTS WHEN HEATED...

... THEN SOLIDIFIES. FURTHER
HEATING WILL NOT SOFTEN IT

WHAT IS IT THAT MAKES GLUE STICK?

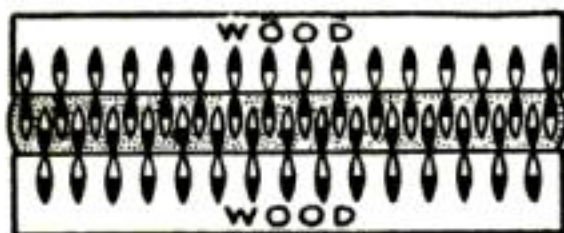


IS IT MOLECULAR ATTRACTION? . . .

Experts have had conflicting theories as to why glue sticks. Some maintain that molecules of the adhesive and of the materials joined are attracted to each other, thereby forming a solid, almost indestructible bond while setting or curing

The diagrams above show the theoretical process of this "chemical weld." The first indicates the glue as first placed between two slabs of material. Next is shown the early molecular action; third, interlocking molecules of the bond

. . . OR IS IT POLAR ATTRACTION?



On the other hand, some molecules are polar, having north and south poles like magnets. These attract other polar molecules (north to south). Hydroxyl molecules of wood, for example, are polar, and act as points of attraction for polar molecules of protein or resin glues. This may be the reason for adhesion

MATERIALS

This powder is one form of synthetic resin glue made from coal products. Flowing freely through the cupped hands at the right, it is obviously far from sticky. But if you put a thin layer of it between two pieces of material to be joined, and then heat it under pressure, a miracle will occur. First the powder melts; then it hardens while it is still hot. No amount of heat can soften it again, and the glue becomes both waterproof and fungus proof; besides which it forms an enduring bond of prodigious strength. By varying the formula of this synthetic glue, its use between different materials is extended indefinitely, but the bond made continues to be practically a weld. The adhesive illustrated and described here is Plaskon, which is one of the numerous trade names under which synthetic resin glues are manufactured and sold.



strength plus ability to stand all kinds of weather, soaking in salt water, even boiling. We have adhesives now that will bond all kinds of materials together—metals, wood, glass, rubber, plastics—with bonds stronger than the materials themselves in many cases. Gluing things together is the ulti-

mate in simplicity, and now that we have adhesives that are just about perfect for all purposes, we can build many things more cheaply than ever before. Some experts say we can build airplanes 10 times as fast as before and at one tenth the former cost.

These new adhesives are all synthetic

THIS IS HOW SOME COMMON ADHESIVES WORK



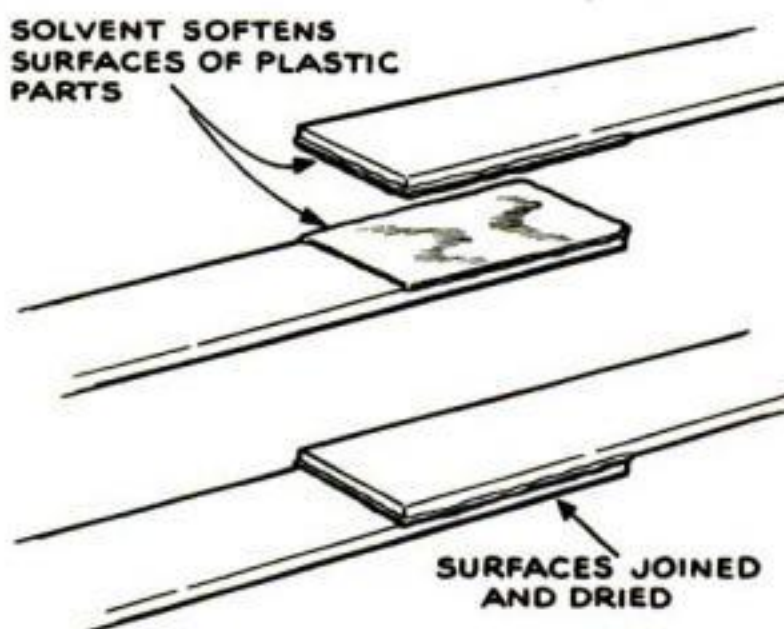
PLASTER holds by forming hooks in lath openings.

Formerly it was believed that glue made its bond in the same way; this has been disproved

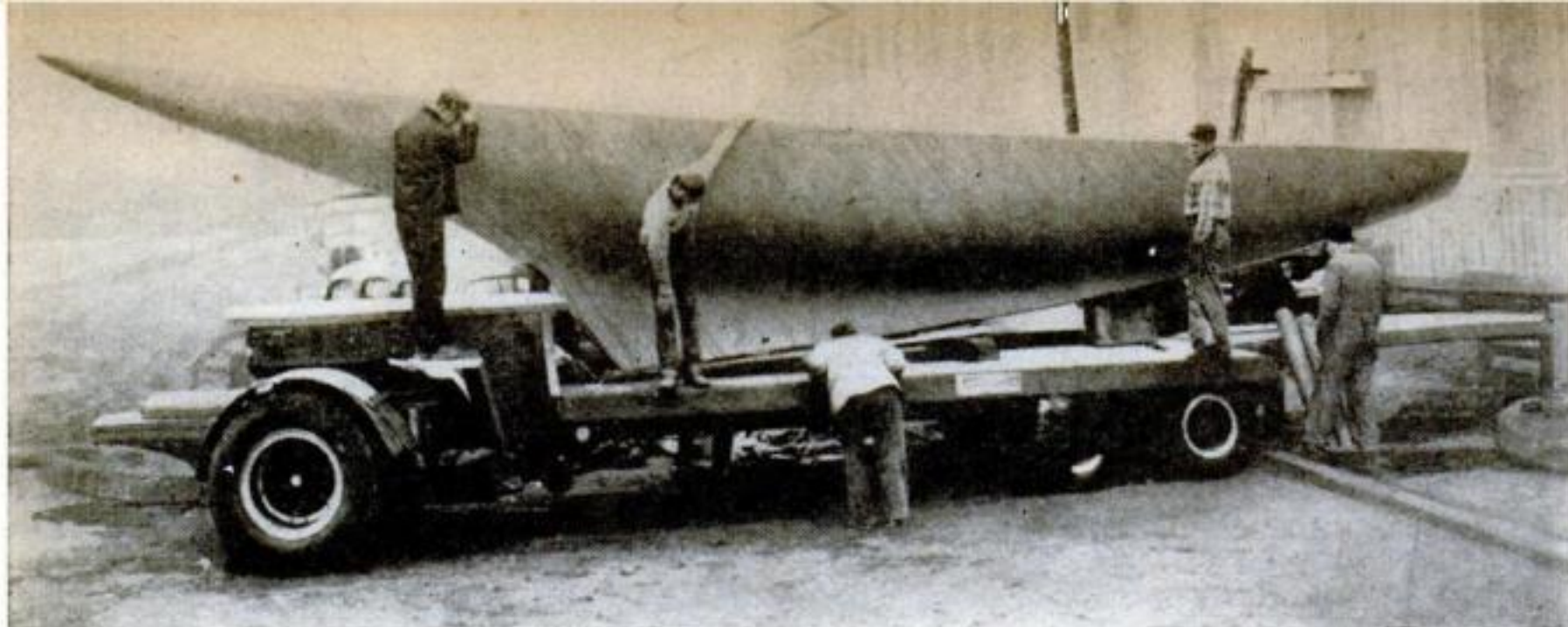


ADHESIVE TAPE maintains its grip through atmospheric pressure. Numerous vacuum cups are squeezed together when the tape is applied under pressure, and held securely by the weight of the surrounding atmosphere

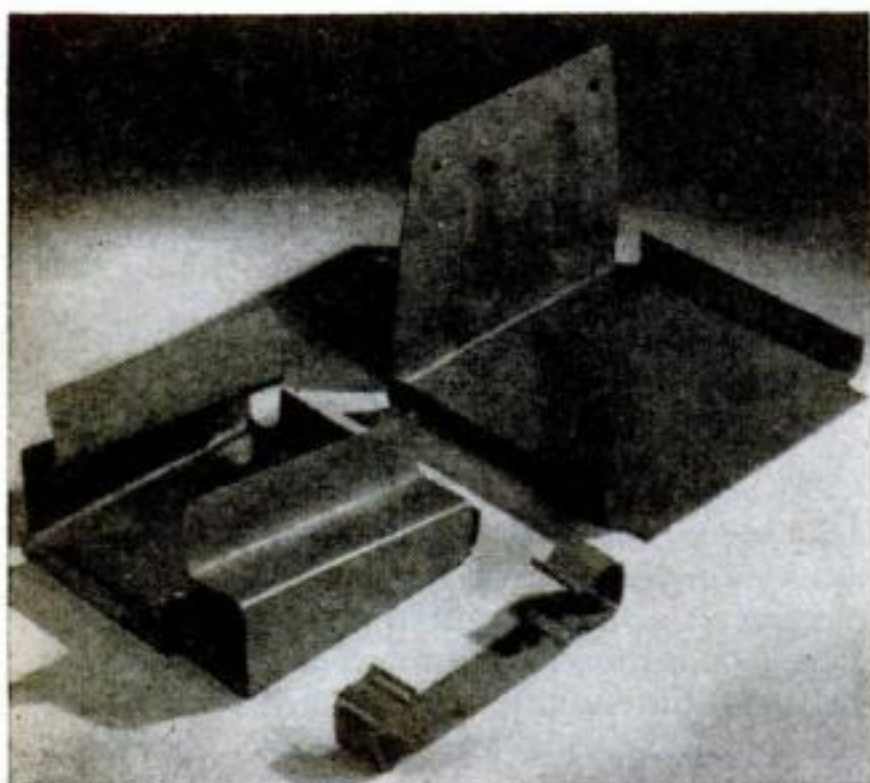
SOLVENT SOFTENS SURFACES OF PLASTIC PARTS



THERMOPLASTICS are joined by applying a solvent such as acetone to the surfaces that will come together. This softens the material itself, and the two sheets are pressed together until dry. The material becomes the adhesive



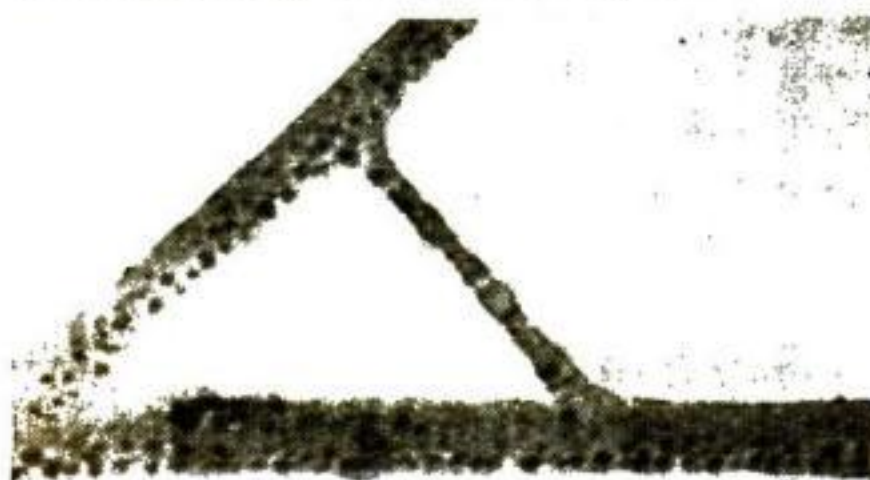
NEW METHODS of manufacture are made possible by today's adhesives. Here is a sailboat hull 38 feet long, molded into one piece from nine plies of mahogany bonded into one piece with waterproof bakelite phenolic glue. The hull was virtually "cooked" into shape. Added advantage is: no seams to calk



NEW MATERIALS are created with the aid of resin glues. These are airplane parts made of fabric laminated with the new adhesives and molded to shape. They're strong and durable as metal

ELECTRON MICROSCOPE MAY SOLVE MYSTERY OF ADHESION

The tiny black spots in the electron-microscope picture below are believed to be molecules, some unexplained action of which accounts for the adhesive power of glue. The magnification (100,000 diameters, greatest ever achieved) shows a minute particle of vinyl chloride, one of the synthetic resins from which many of the modern glues are made



products of chemistry and are very closely related to the plastics. They are derived from coal, oil, alcohol, and limestone; older glues came from hoofs and hides of animals, cow's milk, or vegetable matter.

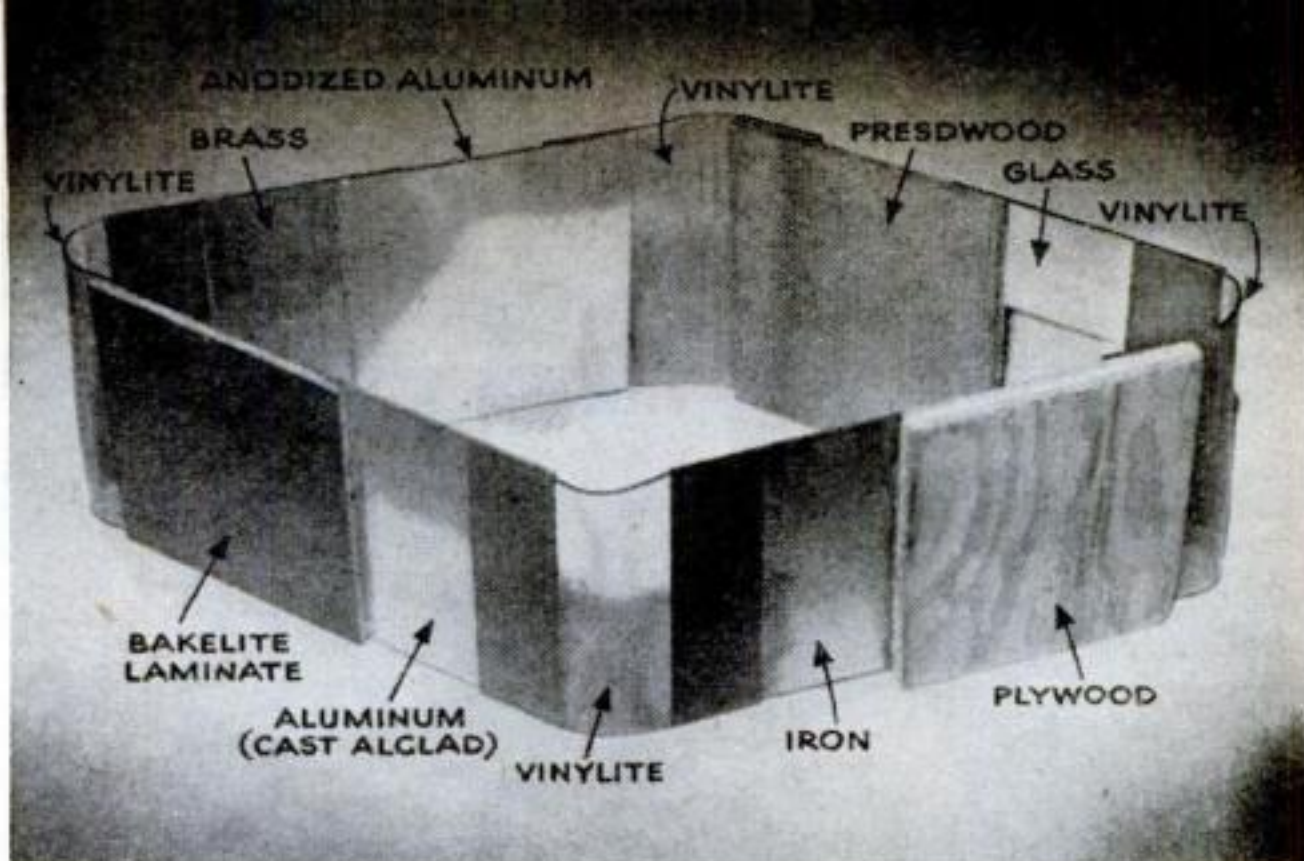
The scientists who have created these amazing new adhesives and the factory experts who use them in so many practical ways are still largely in the dark as to why they stick with such tenacity. The whole question of why glues hold things together has been intensively examined in the course of research and development. Better and better adhesives are being produced all the time, but still there are only theories as to why this or that one does the miraculous things that it does.

However, the commonest explanation of all has been thrown overboard. This is the idea that glue fills the pores of the materials being joined and thus forms many small hooks or spurs that act as anchors when dried hard. This theory had to be abandoned when it was discovered that the smoothest materials could be joined with the strongest bonds. Microscopic examination of glue lines further showed that there are not nearly enough hooks or anchors to account for adhesion even in gluing soft woods. In gluing glass to glass or metal to metal, there obviously is no such penetration of glue into the material as to account for shear strength of 4,000 pounds to the square inch.

All presently held theories are based on physical or chemical reaction between molecules in the curing or hardening process. The new resin adhesives are cured by polymerization—the clumping of small molecules to make larger molecules which form a new compound. This is brought about either by application of heat or by the addition of a catalyst or chemical setting agent, as in the case of the so-called cold-setting resins. In either case the reaction that takes place changes the resin into a different com-

ALL KINDS OF MATERIALS CAN BE BONDED

This is a show-off piece that demonstrates the versatility of synthetic-resin adhesives. By modifying formulas, almost anything can be bonded to itself or to anything else—aluminum to plastics to wood to glass, and so on. The ring shown here was glued with various modifications of Cordo-Bond



pound by the union of two or more molecules. This same union of molecules, or something akin to it, evidently takes place also between the adhesive itself and the materials brought into contact with it during the curing process. This would be a sort of "chemical weld." But no one theory would seem to account for all of the remarkable bonds that are being accomplished with virtually all kinds of material.

Champion of all in waterproof qualities is phenol-formaldehyde glue, derived from phenol, which is carbolic acid. This is the stuff that has stood six years of repeated soakings at the U. S. Forest Products Laboratories and come out with a report card that stated that the glue showed no more deterioration than the wood it joined. This is the stuff that stands boiling without giving way. Once it is set, no amount of heat can melt it. A large family of plastics also is derived from this same phenol-formaldehyde. Other synthetic-resin glues also classed as waterproof under Army and Navy

specifications are melamine, urea, resorcinol, and furane.

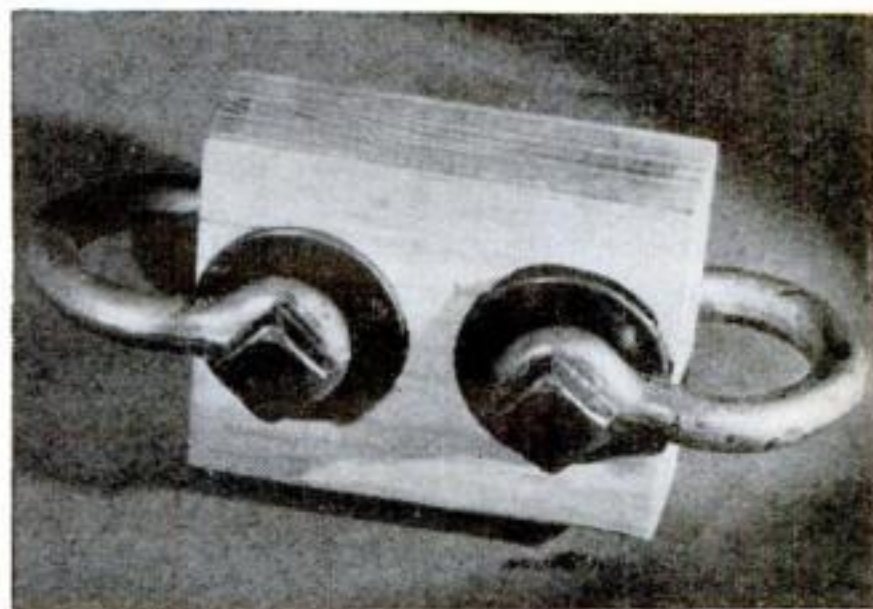
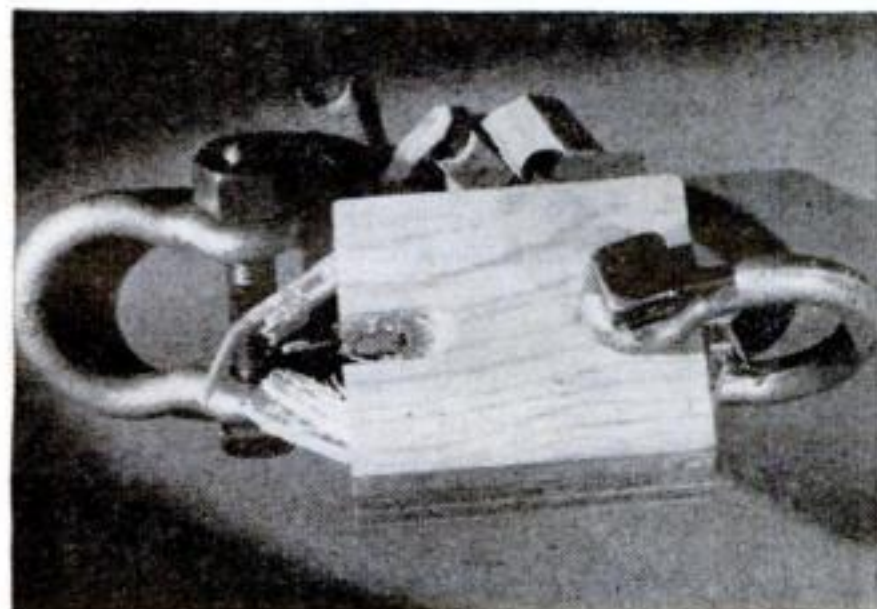
Just how resistant these glues are to water and wetness may be judged by these typical wartime uses of wood glued with them: torpedo boats, landing barges, all-plywood invasion craft, pontons and ponton-bridge tracks, mine sweepers, mine layers, coastal patrol boats, all-plywood gliders, transports, training planes, bombers, auxiliary gasoline tanks for planes, laminated wooden arches for large buildings and bridges, outside walls of barracks, hutments, and housing projects.

Biggest news in the adhesive industry just now is the creation of phenolic-type resins that will set without heat. This development is of utmost importance because it permits the use of these waterproof glues without access to the equipment found only in large factories. It means that truly waterproof joints can be produced in the smallest factory, by the cabinetmaker, the carpenter, the amateur craftsman. This glue is a liquid

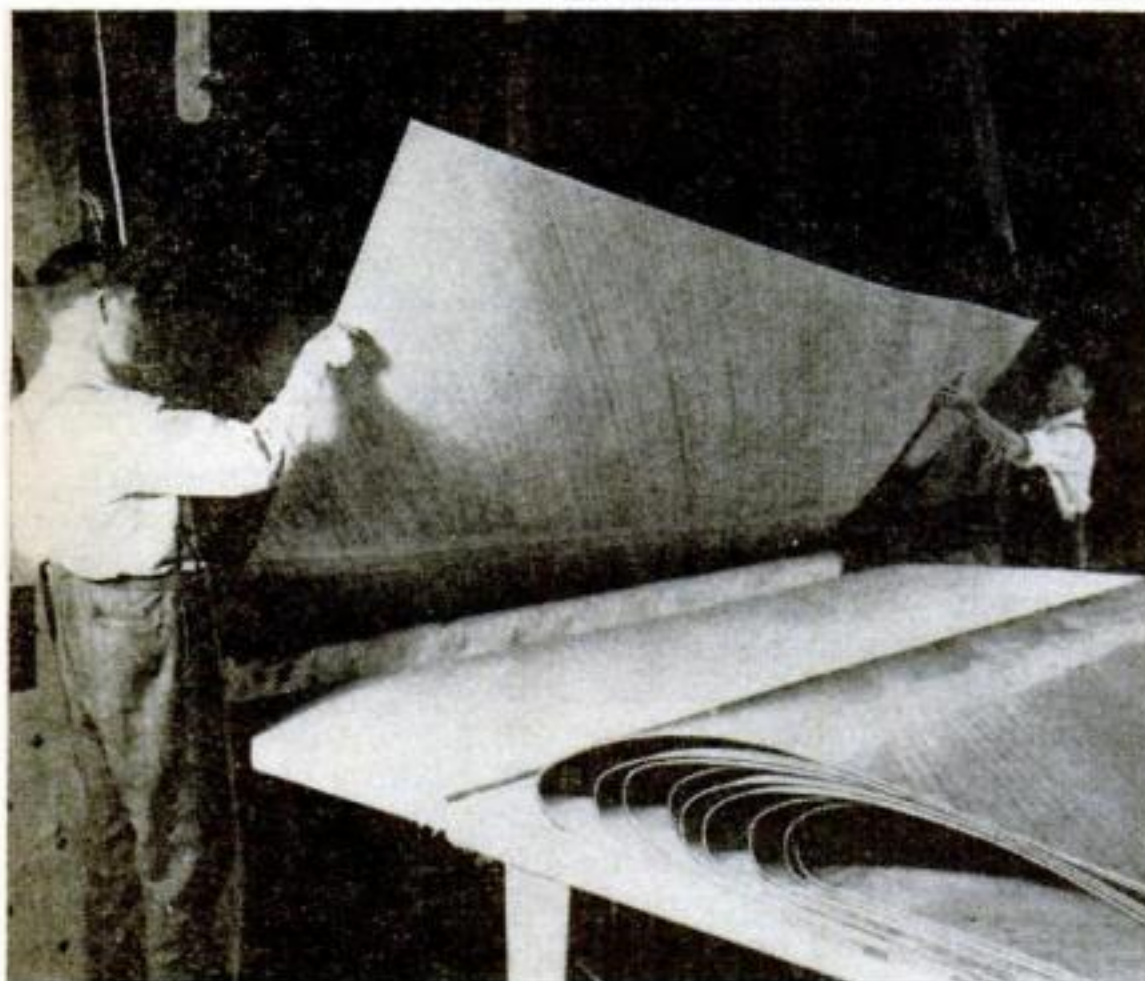
NEW GLUES ARE STRONGER THAN THE MATERIALS THEY JOIN

Two clevises were bolted to a seven-ply block of hardwood, as shown below. When the setup was put in a testing machine, it required 1,400 pounds of pull to draw one bolt out of the tough wood fiber

An identical block, drilled the same way, but with iron washers glued on with Cordo-Bond, was subjected to a 4,000-pound pull, but did not give way. Four glue spots added 2,600 pounds' strength



MADE OF WOOD,
even to the fuel tanks,
the Army's AT-10 bomber-
pilot trainer is produced
by Beechcraft with resin-
bonded plywood. Below,
a hot-bending press is setting
three-ply 3/32-inch mahogany
into shape for leading edge
on airplane wing. Plywood
is bonded with urea resin



strength are produced from various synthetic resins, and some from a combination of these resins with natural or synthetic rubber cements. By different formulas, metal-to-wood and other combinations of materials are firmly bonded. Rubber and metals are now joined with bonds so strong that the toughest rubber gives way before the adhesive. Cycleweld is the name given to one of these bonding processes developed by the Chrysler Motors Co. (P.S.M., Aug. '44, p. 126). It is in wide use by some 50 manufacturers in fabricating plane parts and other equipment of many kinds. The Goodyear Tire & Rubber Co., which co-operated with Chrysler in developing the adhesive formulas,

also produces them under the name of Pliobond. A special development by Goodyear is the bonding of extremely thin veneers of wood to sheet metal. So strongly do the two materials adhere that they are almost as one. The combination sheets can be bent to sharp curves, sheared, stamped, and even welded to other metal. Many uses are possible for such a material, such as house, office, and automobile interiors; panels for planes, trains, busses, and furniture. The strength of metal combined with the rich appearance of fine wood would seem to offer a limitless variety of ways in which it could be employed.

Other adhesives of this type are produced by the U. S. Stoneware Co., under the name of Reanite, (P.S.M., Jan. '44, p. 115); by Consolidated Vultee Aircraft Corporation, under the name of Metlbond; by the Resinous Products & Chemical Co., under the name of Redux; by Cordo Chemical Co., as Cordo-Bond.

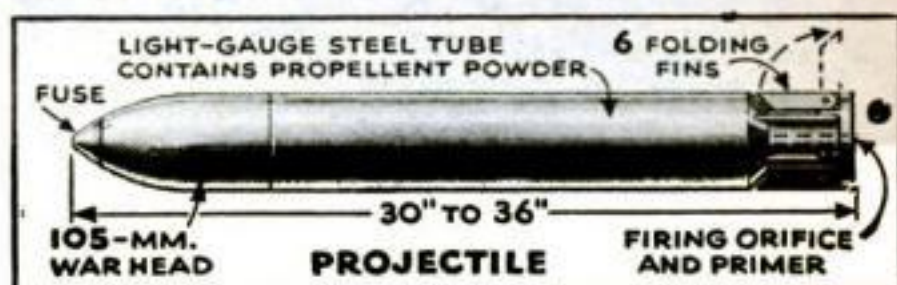
that will set at room temperature—anywhere from 75 degrees F. upward, but it will set only after the proper catalyst is added. It requires no more than the ordinary degrees of pressure such as can be applied with clamps. This glue is far superior to cold-setting urea resins that have been in wide usage for several years. Not only is it more waterproof, but it requires less critical technique to handle. Cold-setting phenolic glue is manufactured at present by two companies. It is put out under the name Penacolite G 1131 by the Pennsylvania Coal Products Co., Petrolia, Pa., and under the name Cascophen RS 216 by the Casein Company of America. Other research laboratories are at work to the same end, and it is expected that all of the large manufacturers will soon be producing similar adhesives.

The uses for such a remarkable glue are almost limitless. With it you can make outdoor furniture without fear that it will fall apart from heat, humidity, or wetting. Since this chemical achievement, it is a mistake to think of glue as something to be used only indoors. It can be employed in almost any form of construction where gluing is more convenient than other forms of fastening.

Metal-to-metal bonds of surprising



Pulling the fuse safety pin on the new 4.5-in. rocket. At right, one man carries the launching tube and projectile in a 50-pound load. Drawing shows the rocket
Official U. S. Army Photo

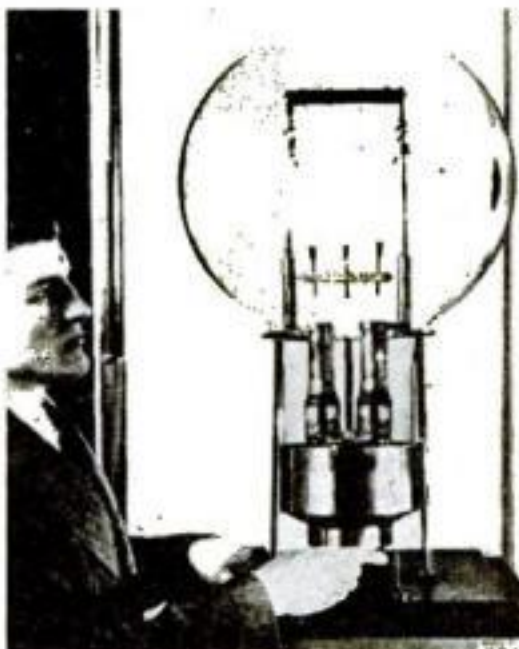


MIGHTIER THAN THE BAZOOKA, the Army's new 4.5-inch rocket launcher packs all the destructive punch of a 105-mm. howitzer and gives the American infantryman the firepower of heavy artillery. Made of fiber and equipped with sights and a collapsible tripod stand, the new weapon weighs less than 50 pounds with its projectile. The launching tube is easily carried

and assembled by one man, who fires the rocket from a safe distance of about 100 feet to one side by means of wires and a battery. Inexpensively made, the launcher is expendable in the field and can be abandoned after firing one round if additional projectiles are not available. Several of the launchers can be grouped as a battery to lay down a terrific barrage.

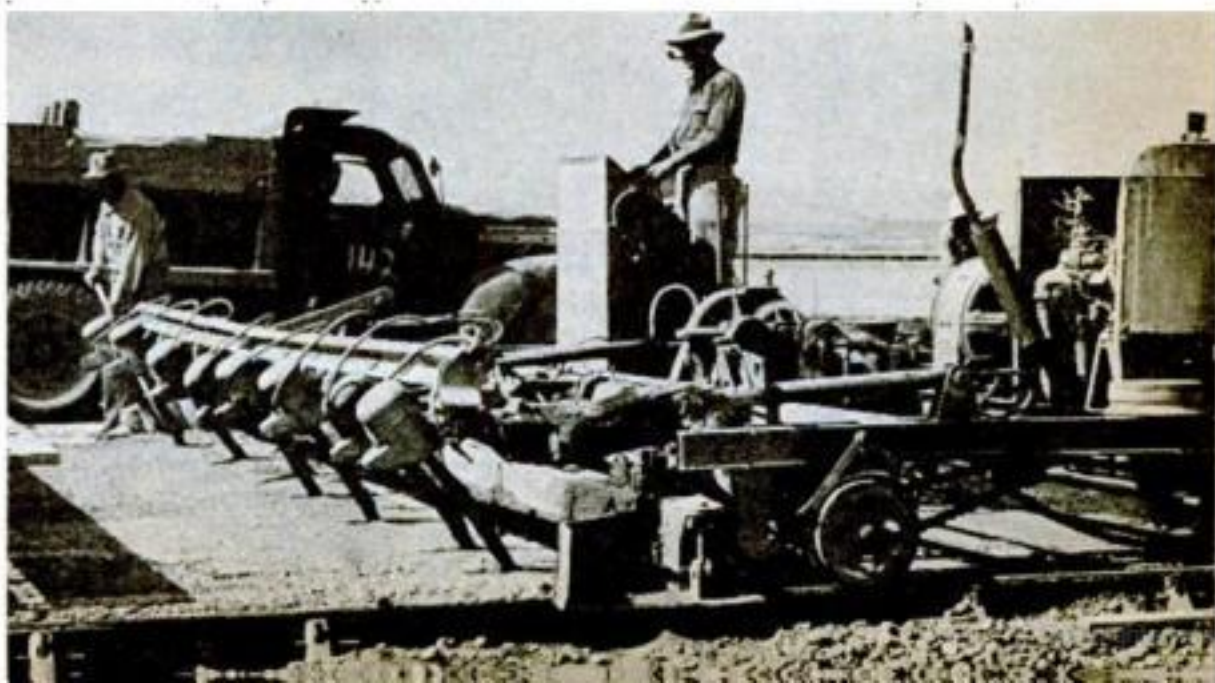


AIRMAN IS SAVED from the water by a blimp using the latest in rescue harness. The device is lowered from the hovering blimp, one of whose crewmen goes down with it to help attach the rig. It resembles a standard parachute harness, and is quickly adjusted even in the water. The spreader bar keeps it from collapsing.



BIGGEST BULB in the world was developed by General Electric Co., Nela Park, Cleveland, Ohio. This incandescent lamp gives light equivalent to that from 2,000 60-watt Mazda-type bulbs. The tungsten filament weighs over three pounds, enough to supply 150,000 40-watt lamps. A larger lamp has been made experimentally; this is a stock model.

SPEEDIER CONCRETE LAYING resulted when this new-type internal vibrator was used on a new 8,500-foot air strip for Consolidated-Vultee Aircraft Corp., Lindbergh Field, San Diego, Calif. This is the longest commercial-field runway ever built.



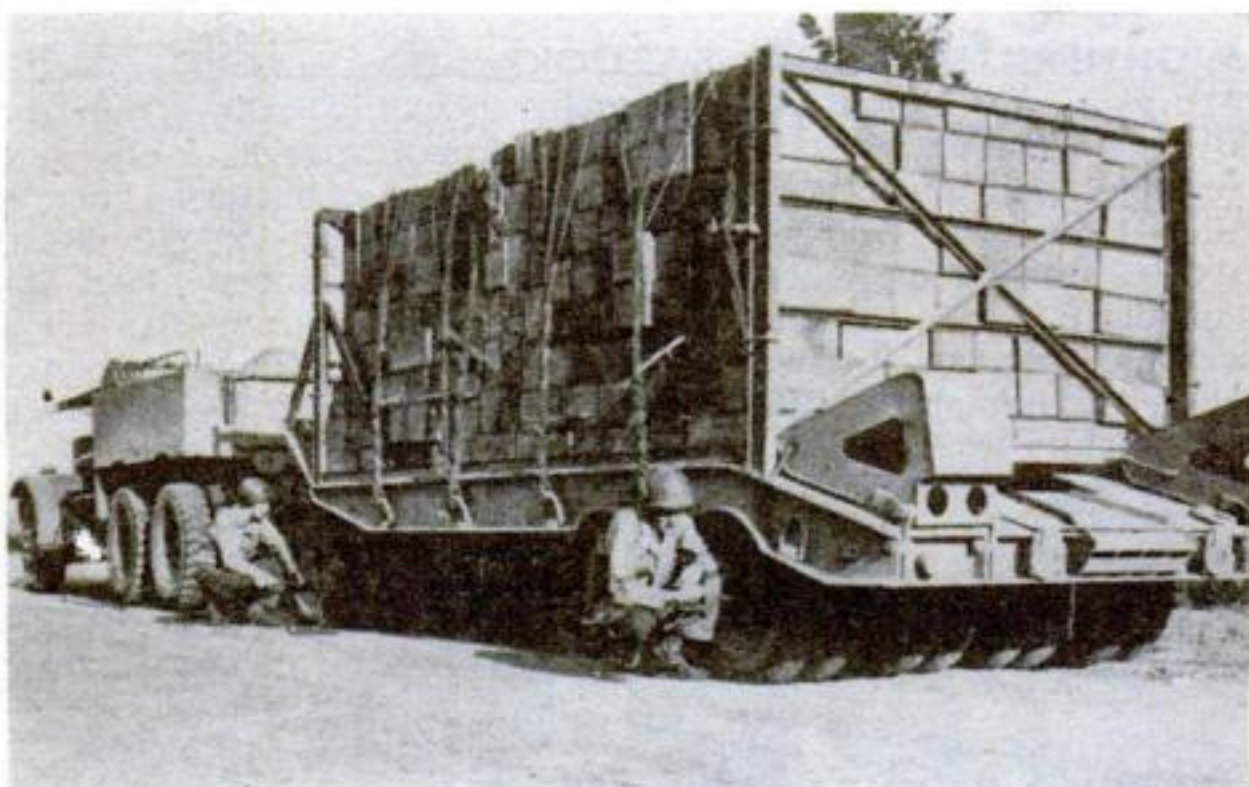


Navy Corsair, extra-powered with two rockets, hot-foots it down the deck of a plane carrier for a take-off. Each rocket gives an extra 330 horsepower

EXTRA KICK for Navy planes taking off from carriers, the water, or airfields is obtained by the use of rockets secured to the fuselage. Each rocket needles the plane with 330 additional horsepower during the take-off period for a quick getaway. When used on carrier planes, as seen at the left, the rockets permit a shorter take-off run. This, in turn, allows more aircraft to be massed on the flight deck for speedy attacks—an important consideration in carrier work.

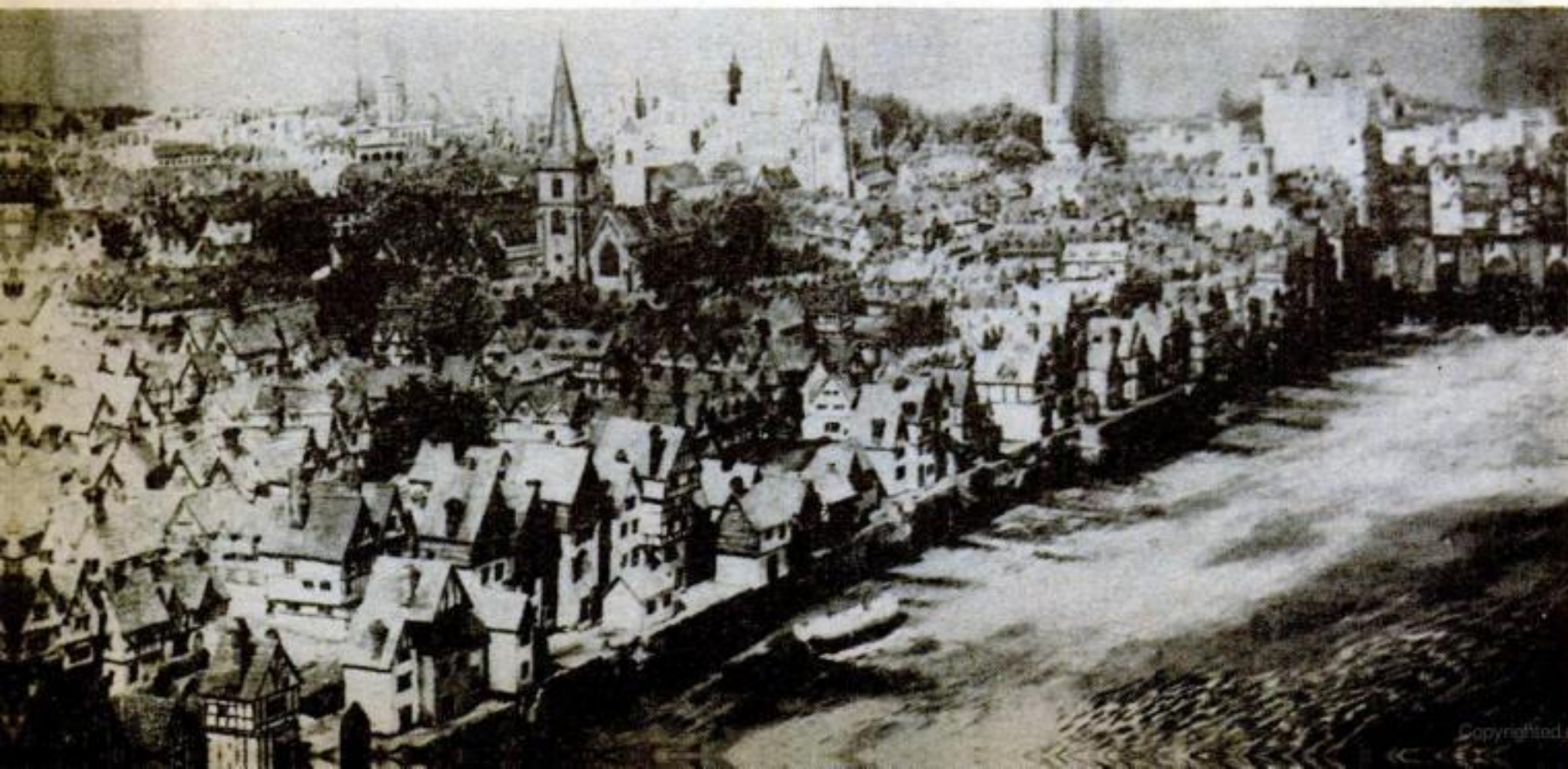
BIG LOAD OF GRIEF

for the enemy has been carried to Allied armies at the front in this "ammo" trailer, which has halted for tire inspection along the road somewhere in France. Since ammunition in large quantities runs to tremendous weights, tank-recovery units, sometimes used for transporting it, must have a sturdy tire equipment. The soldiers shown are examining the rubber on the 34 wheels of the setup.

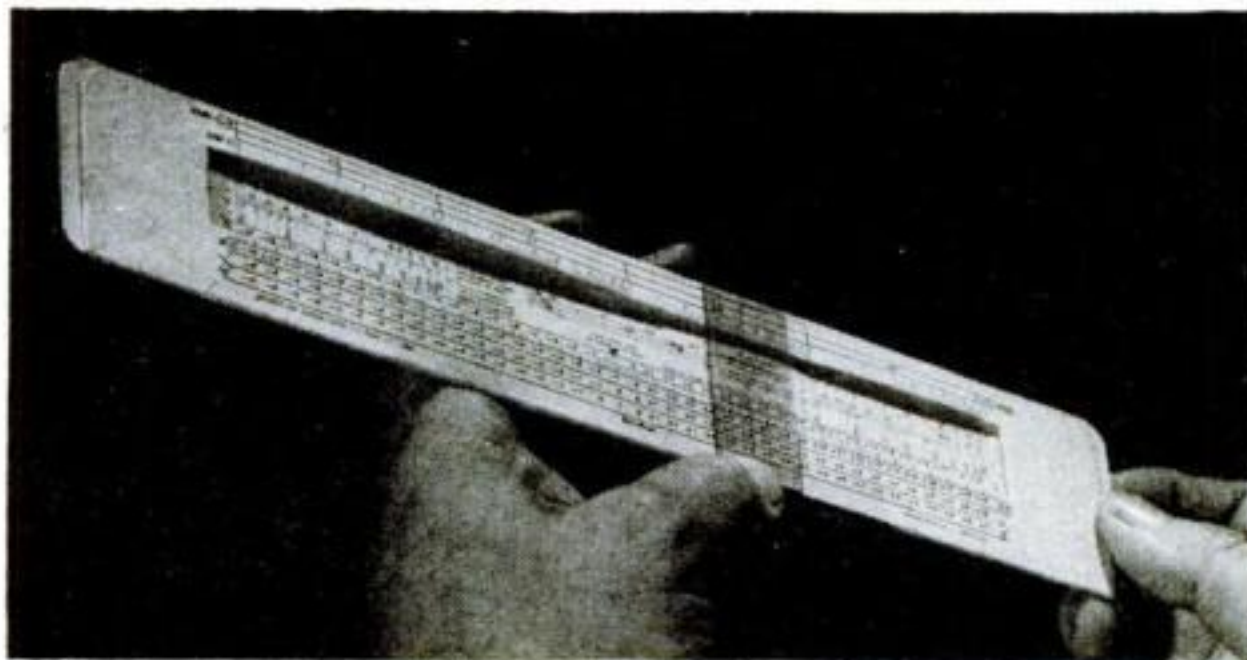
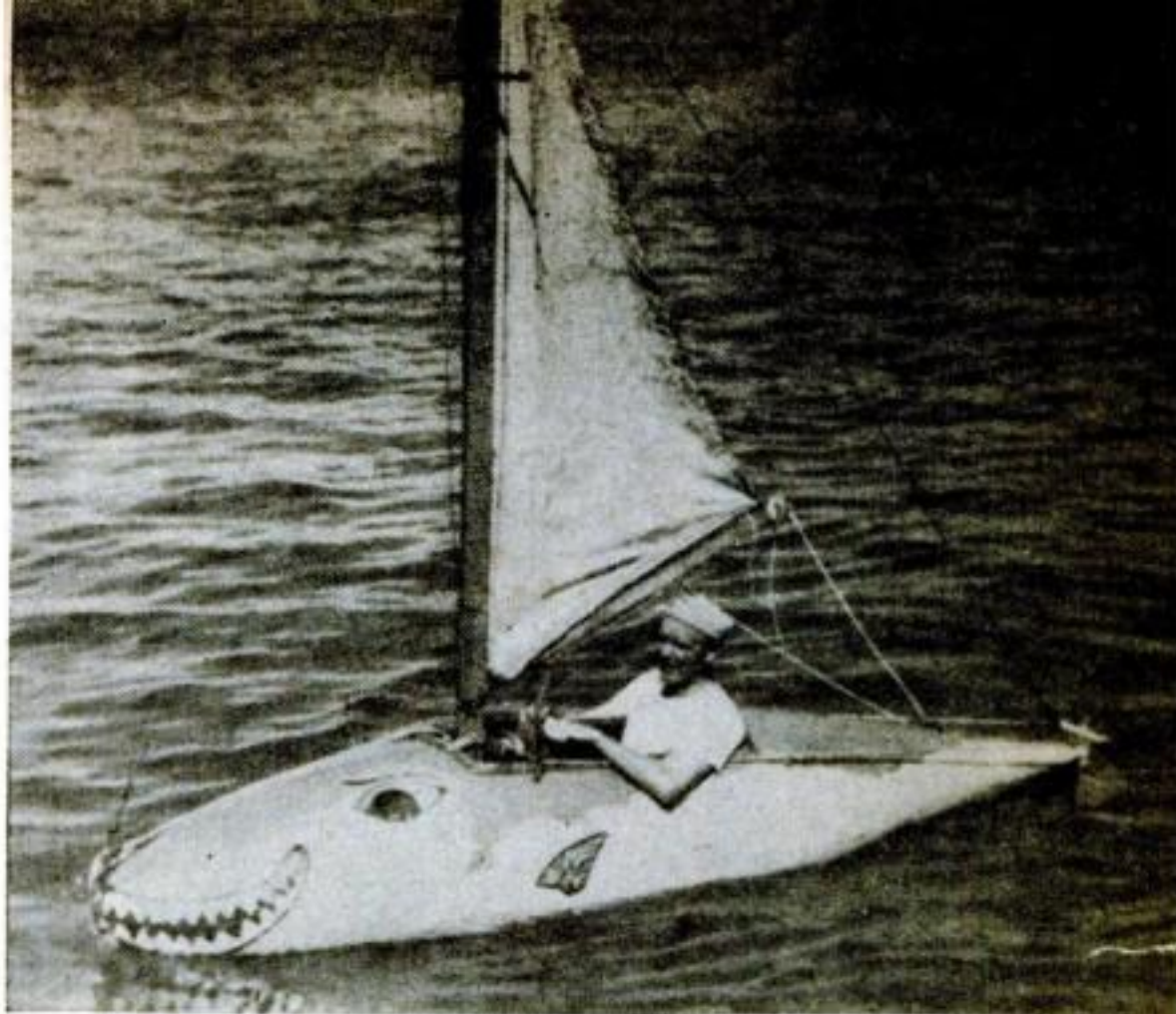


SHAKESPEARE'S LONDON. Constructed for use in the filming of "Henry V," this 70 by 50-foot model of London shows the city as it is believed to have appeared in the late sixteenth and early seventeenth centuries. Most of the buildings represented

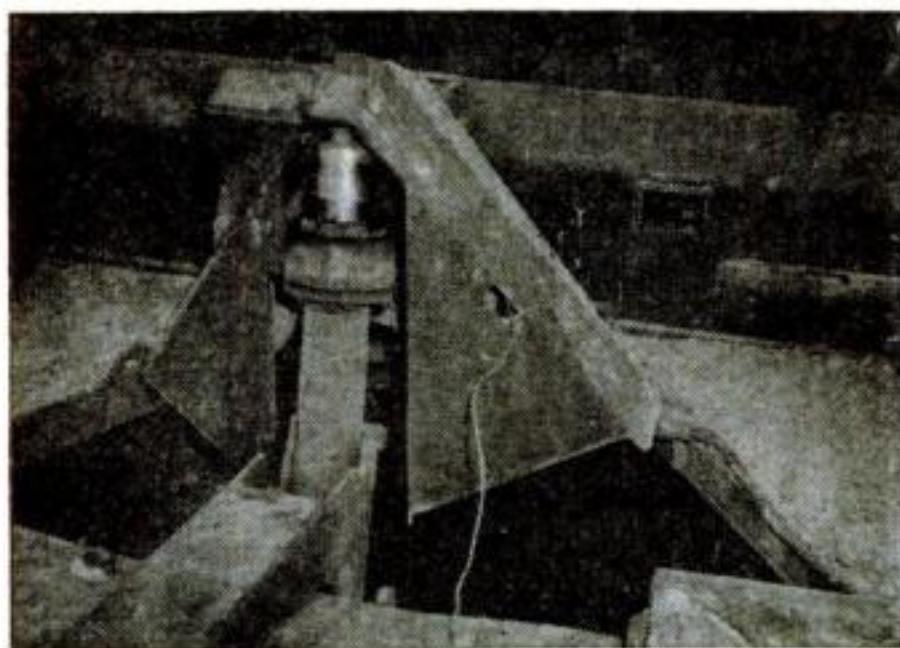
here were destroyed later by the Great Fire of 1666. The model, which took nearly a year to build, shows the city from the River Thames. The original London Bridge is seen near the upper right-hand corner, with the Tower above it to the left.



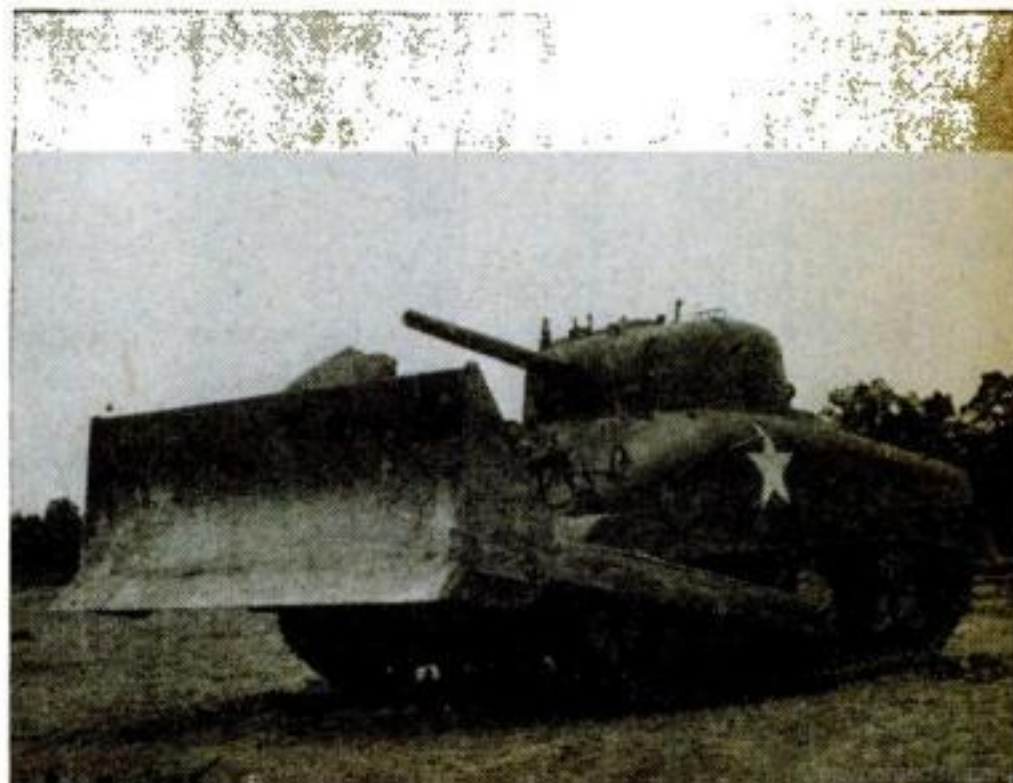
IT'S REALLY A GAS TANK, an auxiliary one that had been jettisoned by an airplane, but Lt. Parker Hatch, commander of the coast patrol ship *St. Augustine*, found it floating free and adapted it for yachting purposes—with the permission of the Air Forces. A square hole was cut in the tank for a cockpit, and a shallow fin keel with 200 pounds of lead attached. Then Lieutenant Hatch hung a rudder on a hanger made of pipe fittings and eye bolts, painted the hull to represent a contented shark, and christened it "*Little Augie*." A mast was stepped in, and from this a single jib-headed sail was set. The yacht was 12 feet over all, while the beam was about 3½ feet. Lieutenant Hatch was subsequently lost when his ship sank in a collision.

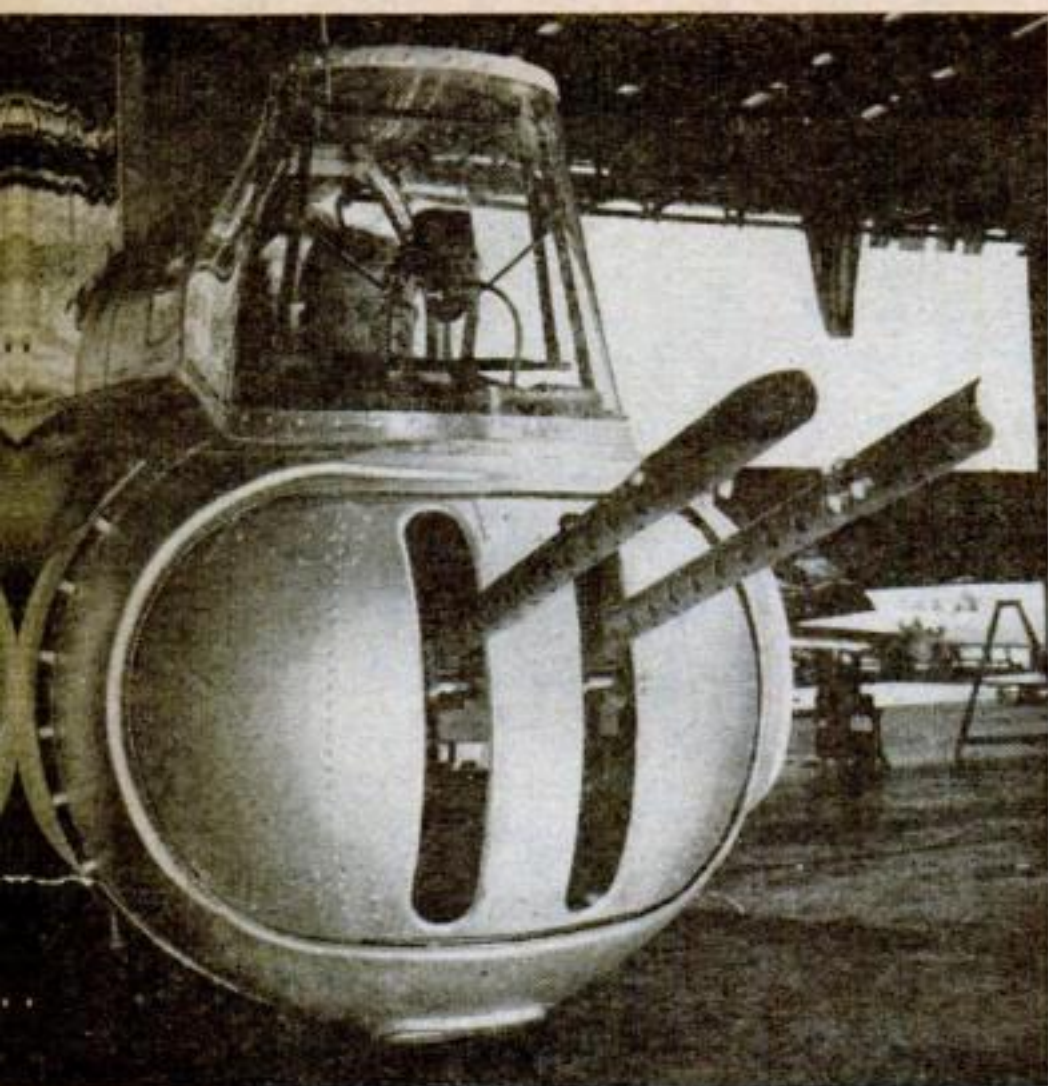


NEW SLIDE RULE, manufactured by Pickett & Eckel, Chicago, simplifies the often complicated process of locating the decimal point in readings. Since the slide rule was invented three centuries ago this problem has been one of the greatest stumbling blocks in its use. The new device will help those who need it to locate the decimal point up to 19 places.



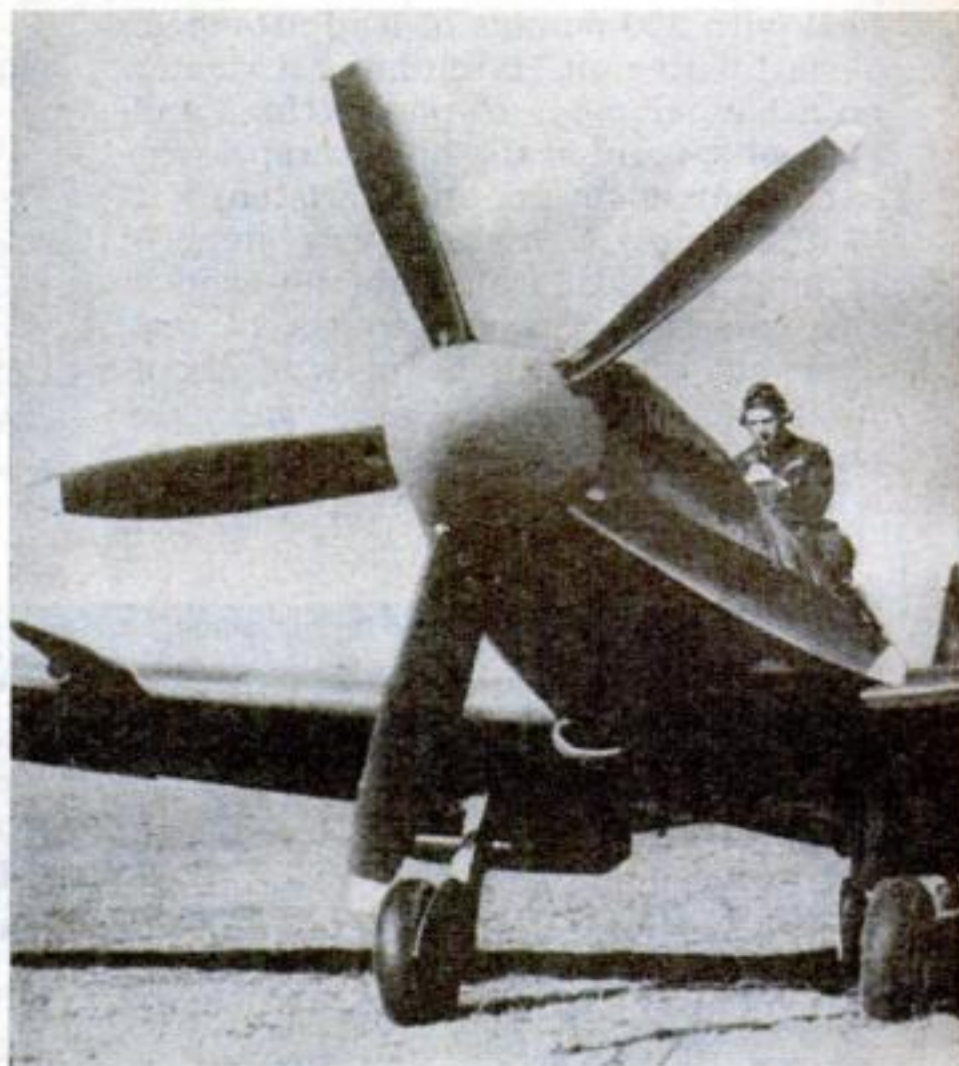
INSIDE STUFF on how the Army's M-4 Sherman tankdozer (below) works is shown in these pictures. The big heavy-shoving blade mounted in front is operated by a hydraulic jack (upper left) powered from inside the tank by a pump driven by the motor. Below (left) is a side view of the forward end of the tankdozer exerting a terrific push on a bank of earth. The steel blade alone weighs about 750 pounds. The tankdozer works under fire.



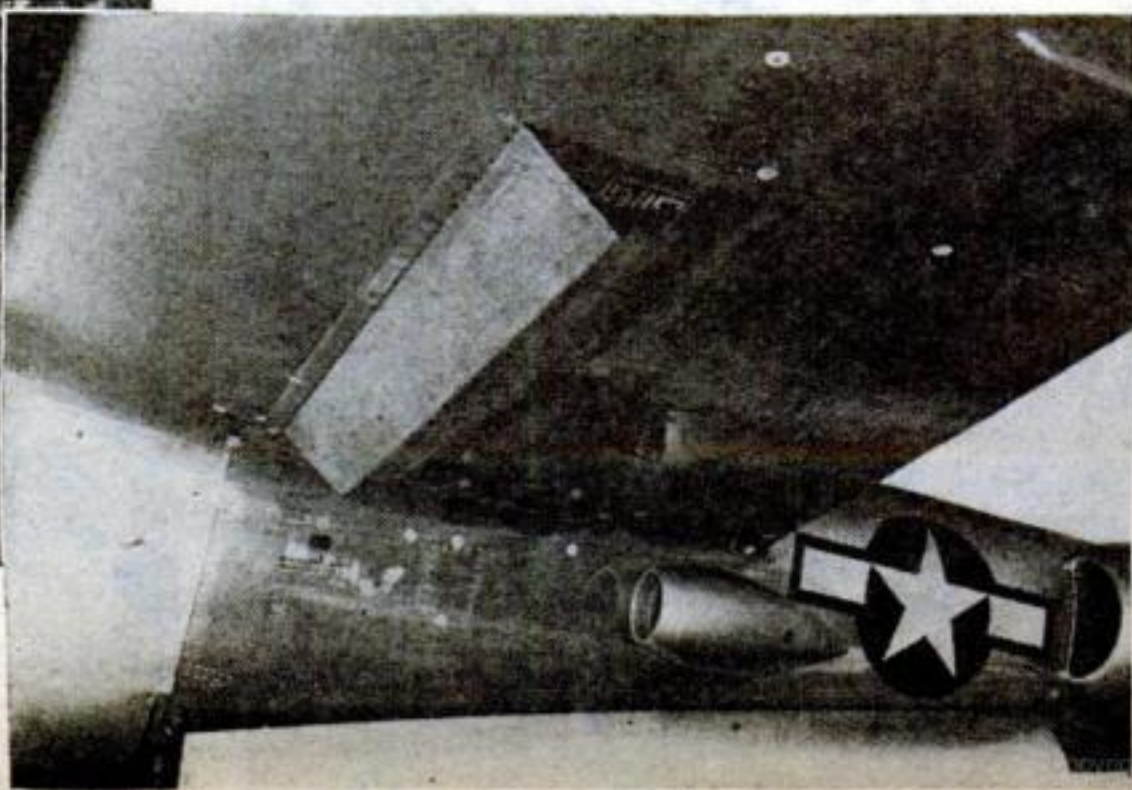


STING IN THE TAIL end of the Boeing B-17 has been stepped up by this new swivel turret, which allows the twin .50 caliber machine guns to swing through a 90-degree arc, or 30 degrees more than formerly. New turret allows 50 percent more firepower than the old. An all-around flak curtain and bulletproof glass protect the gunner.

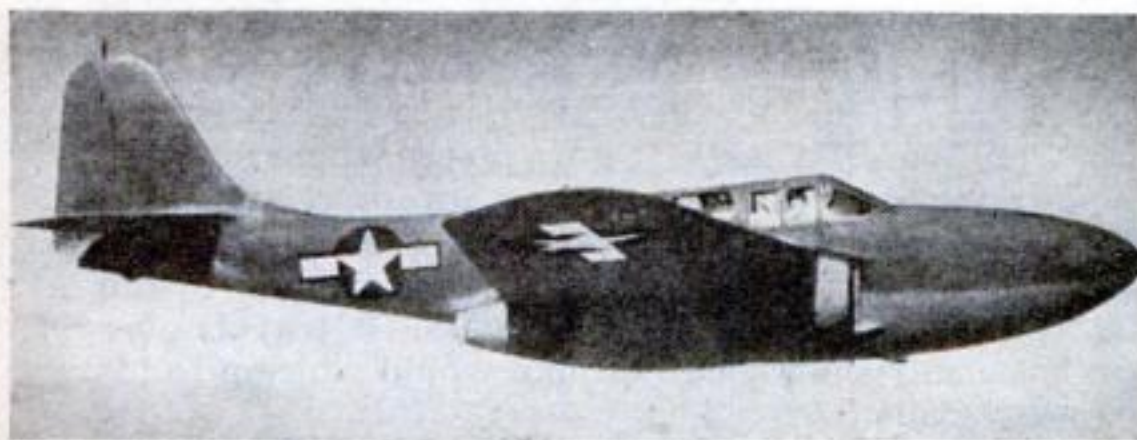
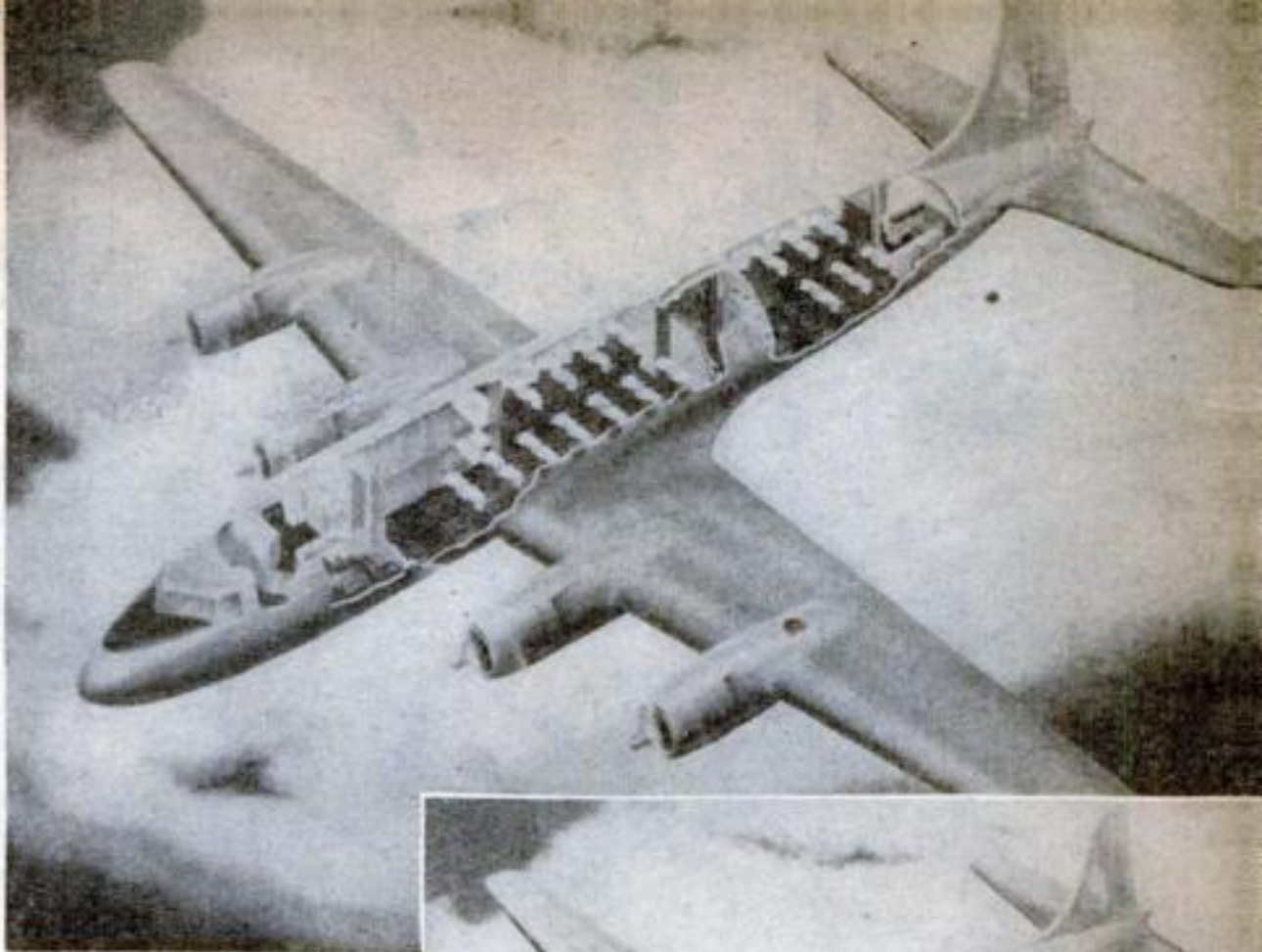
PINWHEEL PROP on new MK XIV Spitfire was developed to handle full 2,000 horsepower supplied by the latest Rolls Royce Griffon 65 engine. For the first time, a five-bladed propeller is used in modern aircraft. Combined with increased power, the prop makes this model even better than Spitfire MK-IX, which itself was good for more than 400 miles an hour.



SHOCK WAVES of compressibility around the engine in high-speed dives are combatted by the airflow-decelerator flaps under the wings of the Lockheed P-38 fighter. Without these, the air around this part of the plane reaches supersonic speed in such dives. The resulting shock waves meet the tail surfaces, and vibration and shock result. These flaps slow the airflow to below the point of compressibility-formed shock waves, thereby saving the tails from buffeting and making the tail control surfaces effective even with the aircraft flying at unprecedented speeds.



THE DC-6 TRANSPORT, a commercial development of the famed Douglas C-54 troop carrier, has been ordered in large numbers by leading air lines for postwar use. Four 2,100-hp. Pratt & Whitney Double Wasps will pull the ship at 300 m.p.h.—enough to speed it across the continent in eight and a half hours, or from New York to Chicago in less than three. A cut-away drawing of the giant liner is seen at the right, and at lower right a conception of the ship in flight. Maximum cruising range will be 3,540 miles. A pressurized cabin and better sound-proofing will be included.

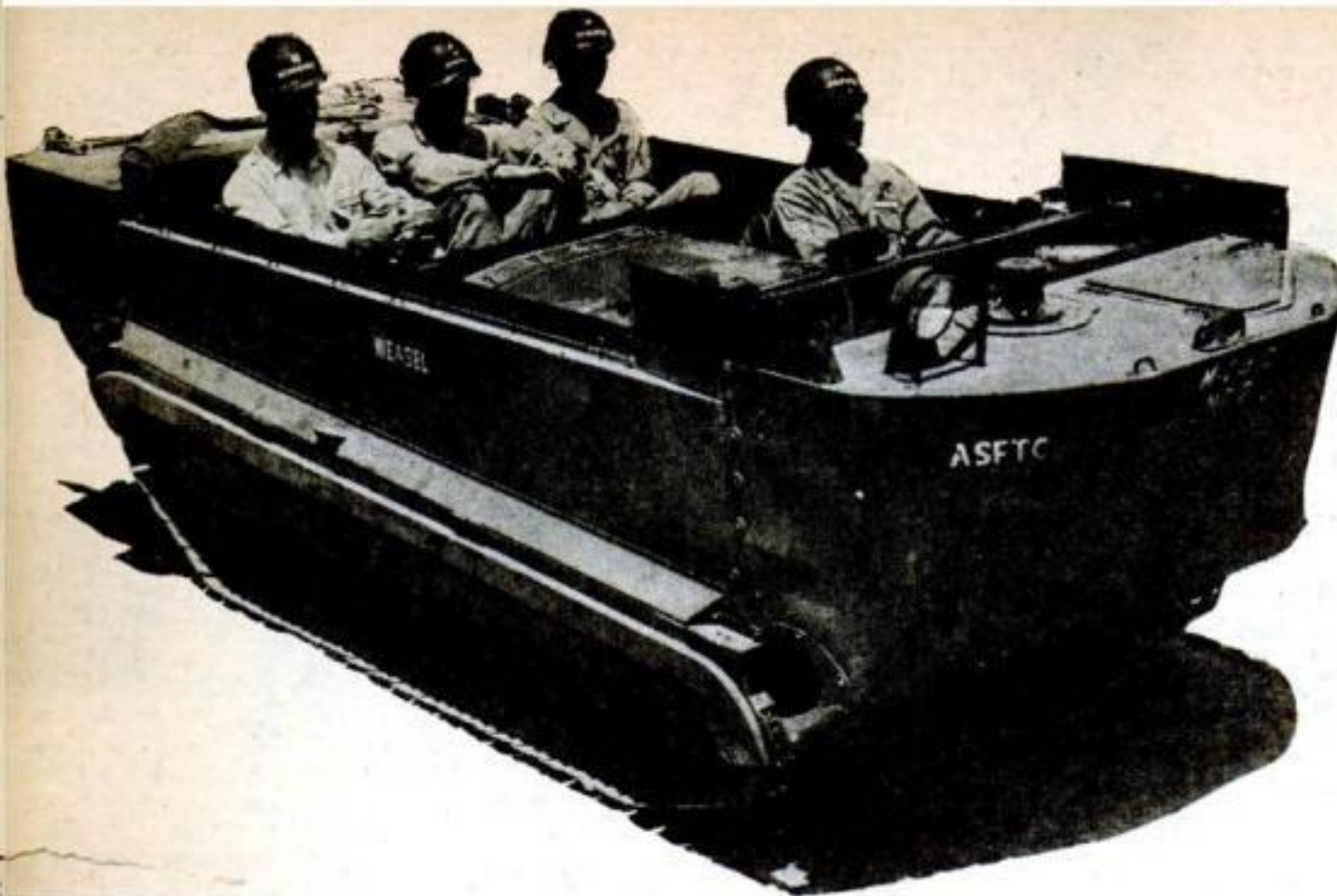


TWO JET PLANES, one the Bell P-59A Airacomet, first ship of this type to be developed in this country; the other, the British Gloucester, are being powered by Whittle jet engines. Twin propulsion units, one under each wing and close to the fuselage, distinguish the American plane (above) from the British, which has but one unit, internally and centrally mounted. The Gloucester (below), because of its unusual maneuverability and tremendous speed, found good hunting in whipping after the Nazi's V-1 robot bombs and blasting them out of the sky before they landed. There is as yet no report of the Airacomet having been used in combat. Both planes operate on the same principle: air is drawn in at the front end of the unit, compressed, augmented with burning fuel, and then discharged out the back end to produce the necessary thrust for flight. In addition to its speed, the Airacomet is also said to have a high ceiling. Performance figures and construction specifications of both fighters are, as yet, military secrets.



EIGHT FANGS in the new nose of the Mitchell B-25 raises the bomber's total of .50 caliber machine guns to 18, 12 of which are fixed, with two in the top turret which also can be fired forward. Remaining four guns are in the waist and tail turret. Designed for strafing, the ship, despite its added armament, also carries a full load of bombs.





At home on land and in water, slimy ooze, or snow, the Water Weasel, one of our hitherto secret military vehicles, carries three men besides the driver, or as much as 1,200 pounds of cargo. Speeds range from about four miles an hour in water to as much as 30 on land. For maneuverability it has six speeds forward and two reverse. There's a watertight tank on each end

Photographs by
WILLIAM W. MORRIS

The Weasel Goes Anywhere...

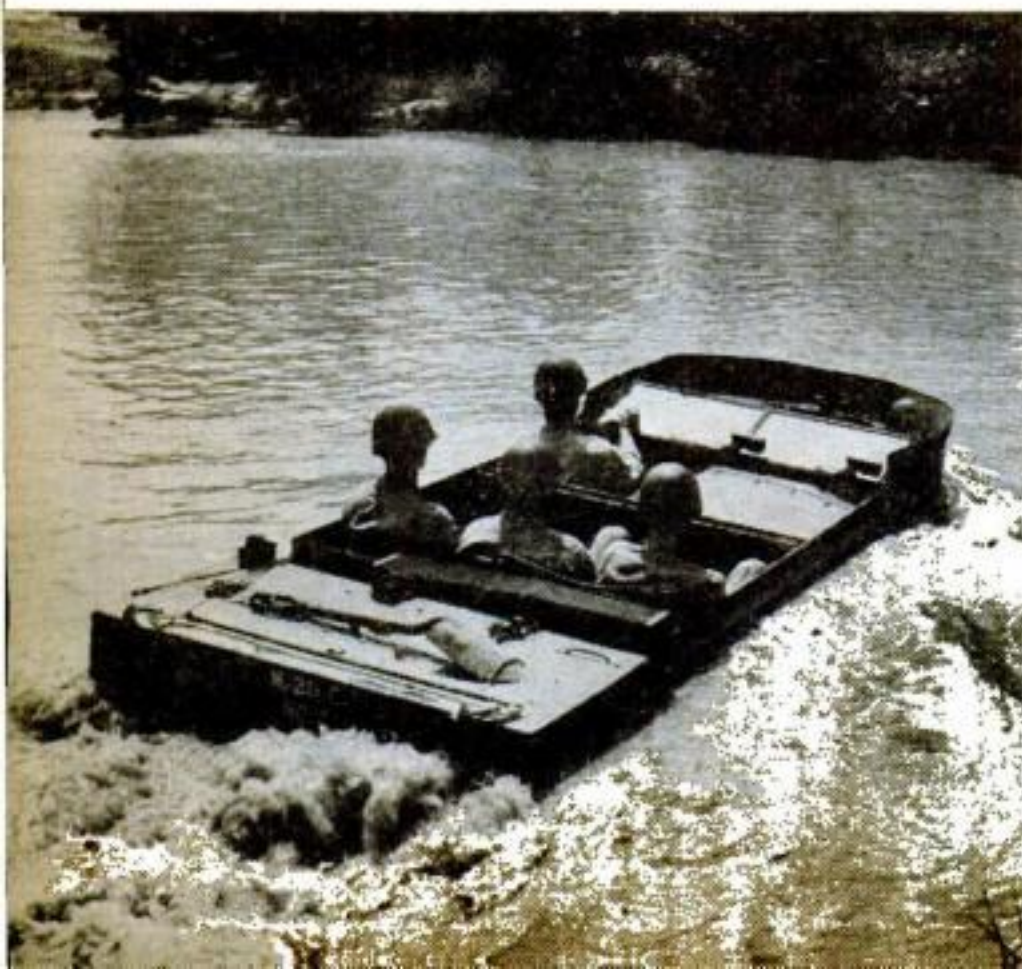
Over lakes and across rivers, through swamps or snow, and up or down slopes no vehicle could ever negotiate before.

With its six-cylinder engine, the Weasel ploughs through heavy underbrush, pushing down shrubs and small trees. Winch is for hauling up steepest banks

Caterpillar tracks serve as propellers through the water, and two rudders steer the aquatic vehicle from a tiller bar in front. As a boat it has only 10 inches of freeboard

HERE'S another of our secret weapons, the M-29c cargo carrier, alias the Water Weasel. It goes places where no other vehicle can. Mud, slime, swamps, and lakes are its meat. It can crawl up an almost perpendicular slope, dive into a pond, swim across, and creep out again. It travels over soft snow where a man would sink up to his waist.

The amphibious Weasel is a refinement on the M-29 cargo carrier (P.S.M., Sept. '44, p. 71), which has been in action against the Japs in the Aleutians, and against the Italians and the Germans on the other fronts. The seagoing version helped us mightily in



POPULAR SCIENCE

getting through terrain flooded by the Nazis in Normandy and Holland.

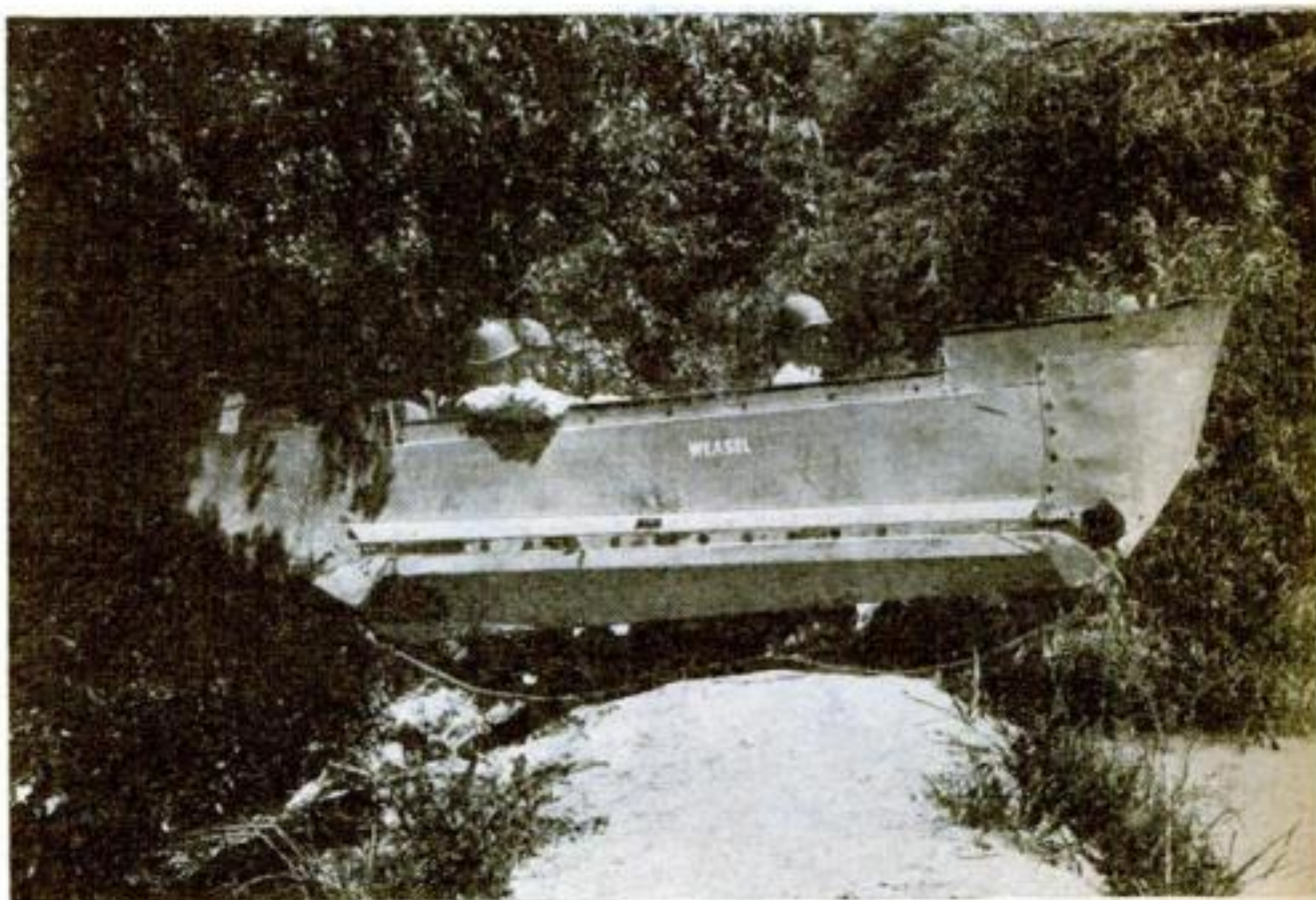
Weighing only 4,700 pounds, the Weasel crawls on two tracks of 20-inch width. It is 60 inches wide, itself, so two thirds of its bottom surface is in contact with the ground. This gives it traction unequaled by any other vehicle, a ground pressure of only 1.91 pounds per square inch with a cargo of 1,200 pounds. This is why it can travel over powder snow where a man would sink, for a man exerts a ground pressure of four to five pounds per square inch through his feet. The Weasel's broad tracks give it a total ground contact of 3,121 square inches. A 2½-ton truck, through its 10 tires, has only 560 square inches of road contact; a jeep, with its four tires, about 140.

The Weasel has gone through several stages of evolution since the first model was built in the summer of 1942 by the Studebaker Corporation to specifications of the Ordnance Department. First, it was designed as a snow buggy to be used against the Japs in the Aleutian Islands; it carried two men and was not amphibious, but it proved itself in short order. The next step was to add watertight tanks, front and rear; now it could swim, using only its tracks for propellers. Steering in water by means of the tracks was found difficult, so the Water Weasel was given two rudders and a simple steering system through small cables.

In water, the M-29c makes about four miles an hour. On land it can do as much as 30. It can climb onto a 2½-ton truck under its own power if the truck is backed up to a bank or mound about three feet high. In this way the Weasel is carried rapidly over highways to climb down again and go



No dammed lake can stop the Water Weasel. Here it is shown at the climax of its climb over the dam. The angle shown is moderate, for the Weasel can crawl up an almost perpendicular slope



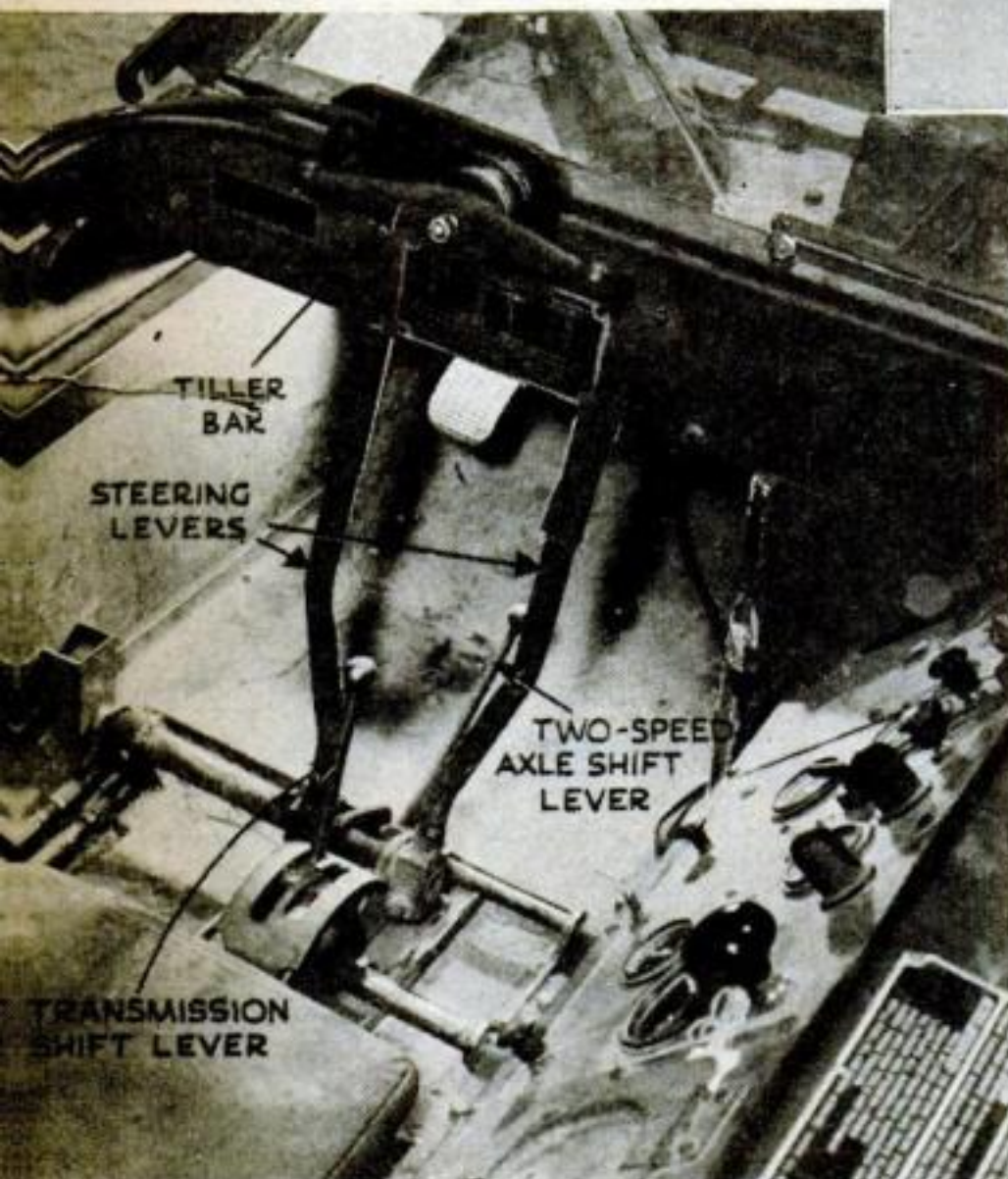
Having arrived at the top of the dam, the Weasel comes to a full stop. To plunge into the water too rapidly might swamp the amphibian, and so the driver, relying on the tracks as brakes, prepares to . . .

. . . ease the water-going truck gently down the steep bank into the lake. The buoyancy of the front watertight tank keeps it from diving, but it goes under the water about 2½ feet on the descent, then levels



Controls are so simple that the Weasel can be driven with reins like a horse. This stunt, demonstrated at right with the land-version M-29, is a lifesaver in crossing crevasses covered by snow

To tractor or truck drivers, the Weasel controls offer no great problems. Land steering is accomplished with the two levers shown below (center); the tiller above moves rudders



ahead when the truck can no longer proceed.

The Weasel can pull itself out of a lake if the bank is just a little less than perpendicular so that it can get a toe hold. If the banks are all too steep, it can still get out by using its motor-driven capstan.

To do all the remarkable things it does, you would think the Weasel must have a terrific power plant. Actually it has nothing more, or less, than a standard Studebaker Champion motor, but it has a two-range axle, which gives it six speeds forward and two reverse. In the lowest gears, the motor turns at extremely high speed and takes a lot of punishment, but these gears are used only in the toughest going. In water, the highest gears are used, and the two tracks throw up a double wake in the rear. There are four sets of four bogey wheels on each side, each set attached to a transverse elliptical spring. The tracks are driven by sprocket wheels in the rear. They are semiflexible, made of light-gauge steel padded with rubber.—GOLD V. SANDERS.



How the rudders are lowered before the Weasel is put into the water. Variation of caterpillar-track speeds, effective on land, is not sufficient for water maneuvers, though tracks act as propellers

Rudders high in the air, the Weasel heads down the steep bank into the lake. Driver steers across the water by means of a simple cable-operated system





This British brute, called the AVRE, is a mortar-equipped tank designed for enemy wall cracking. It hurls a projectile (above), known as "the flying dustbin," which holds an explosive charge many times the weight of that in any other similar-sized projectile



Fired from tank mortar (above), "the flying dustbin" had this effect on a concrete wall. It destroys concrete 10 feet high and 10 feet thick

BLASTING AND SEARING THE ENEMY

are the purposes of the British mortar tank and tank flame throwers seen on this page. The AVRE, shown directly above, gets its name from Armored Vehicle (Royal Engineers). The mortar mounted in the turret, known familiarly as the "petard," hurls a devastating charge of explosive, as may be seen in the photograph at left. The British term for the projectile, "flying dustbin," is explained by the fact that "dustbin" is British for "ash can."

The "Crocodile" and "Wasp" flame throwers shown below are armored blowtorches that can be carried forward under fire to attack enemy strong points. The former is effective at ranges up to 150 yards or more. American tanks are now also equipped with similar weapons.

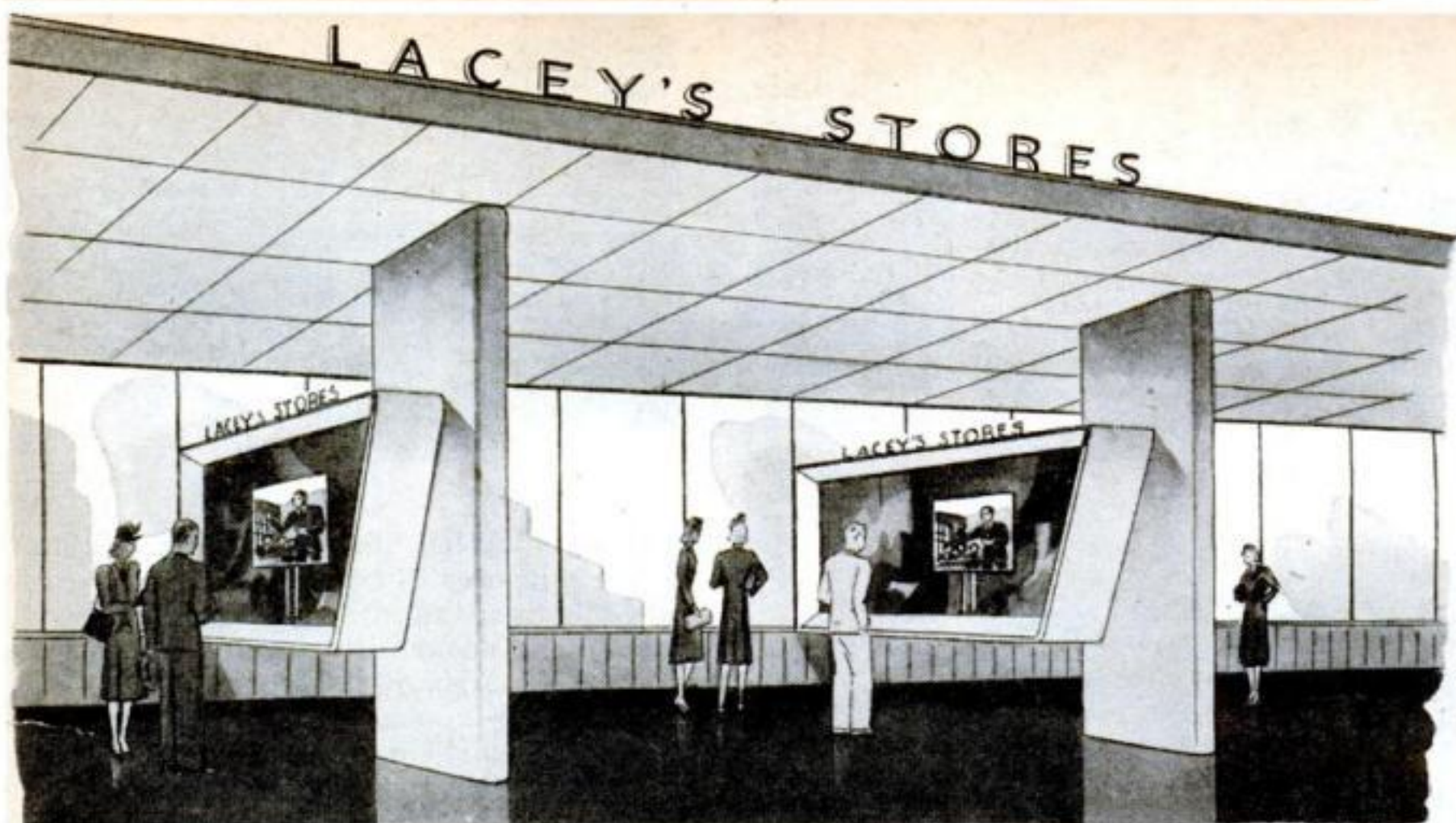


Most effective flame thrower in British army is the "Crocodile" fitted to a Churchill tank. At left, the projector muzzle in the tank's nose is shown; below, flame spurting 150 yards. Special new-type fuel is towed by the tank in a large armored trailer



Another British fire demon is the "Wasp," a hornlike projector fitted to an armored carrier. Here it is shown in action (below) and close up for a view of projector





ELECTRONICS

TELEVISION window displays, in a modernized plan, avert sidewalk jams created by pioneer attempts. In an arcade recessed from the building line, viewers watch shop exhibits without obstructing the passers-by.

Images on the viewing screens are automatically brightened or dimmed by a photo cell which responds to changes in outdoor light; and another control regulates sound volume to be comfortably audible above street noises, but not loud enough to be objectionable outside. Merchandise is attractively arranged about the 18 by 24-inch screens, which may eventually be enlarged to three by four feet or more.



METEOROLOGY

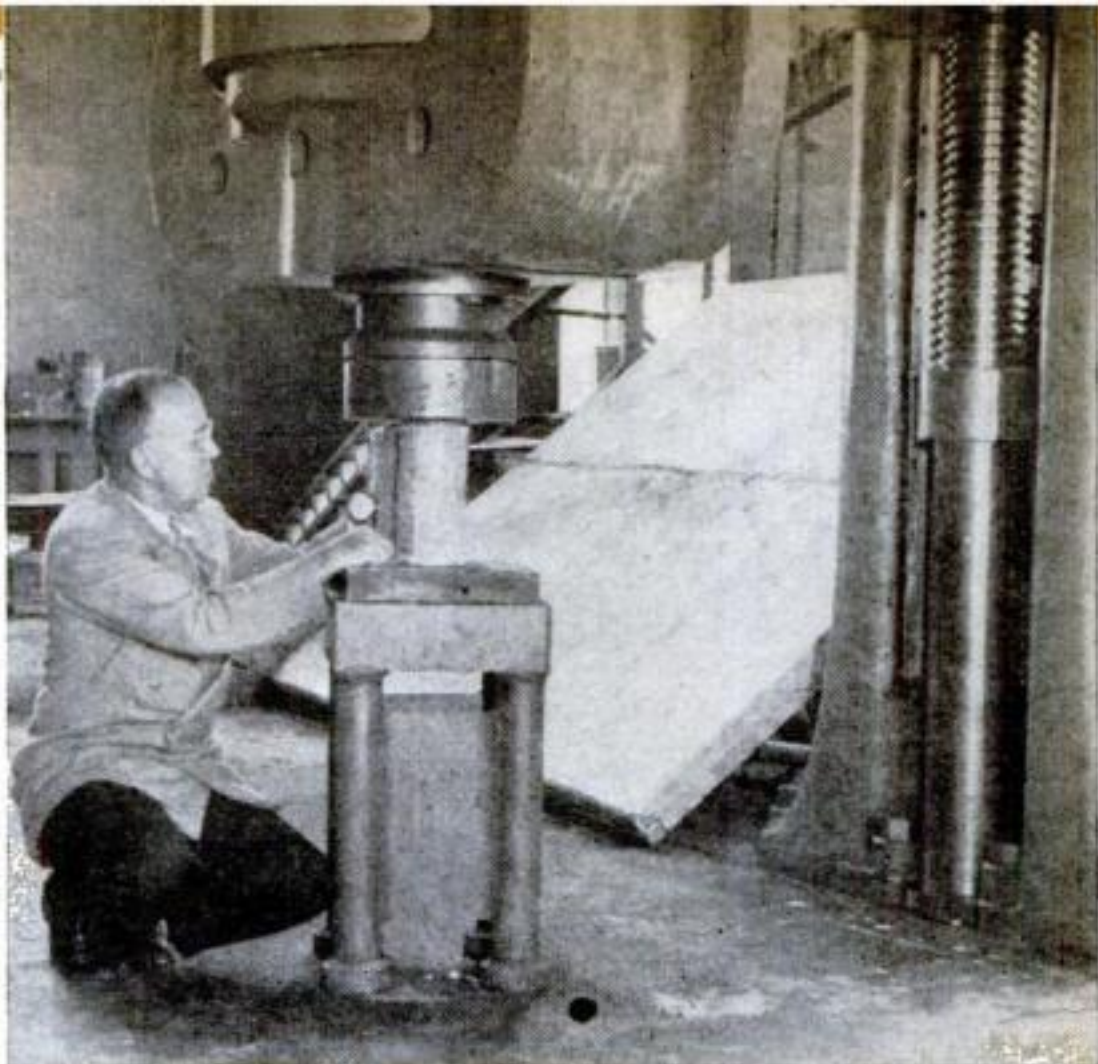
PORTABLE RAIN GAUGES, now in use with the armed services, speed and simplify the work of weather men attached to fast-moving units. Transparent cylinders of shatterproof plastic replace the copper tubes of standard instruments, and readings may be taken at a glance by sighting at a graduated scale, as shown at left. In the conventional type, measurements of precipitation are made by inserting a graduated rod into the copper cylinder.

Compact in size, the new rain meter fits its purpose as well as the bulkier installations employed at permanent weather stations, which it resembles in principle. A funnel four inches in diameter collects rain in a small inner tube, thus multiplying the reading for precision. Overflow, draining into the outer tube, is poured back for measurement. The plastic scale is declared to serve with satisfactory precision in tropical heat or Arctic cold.

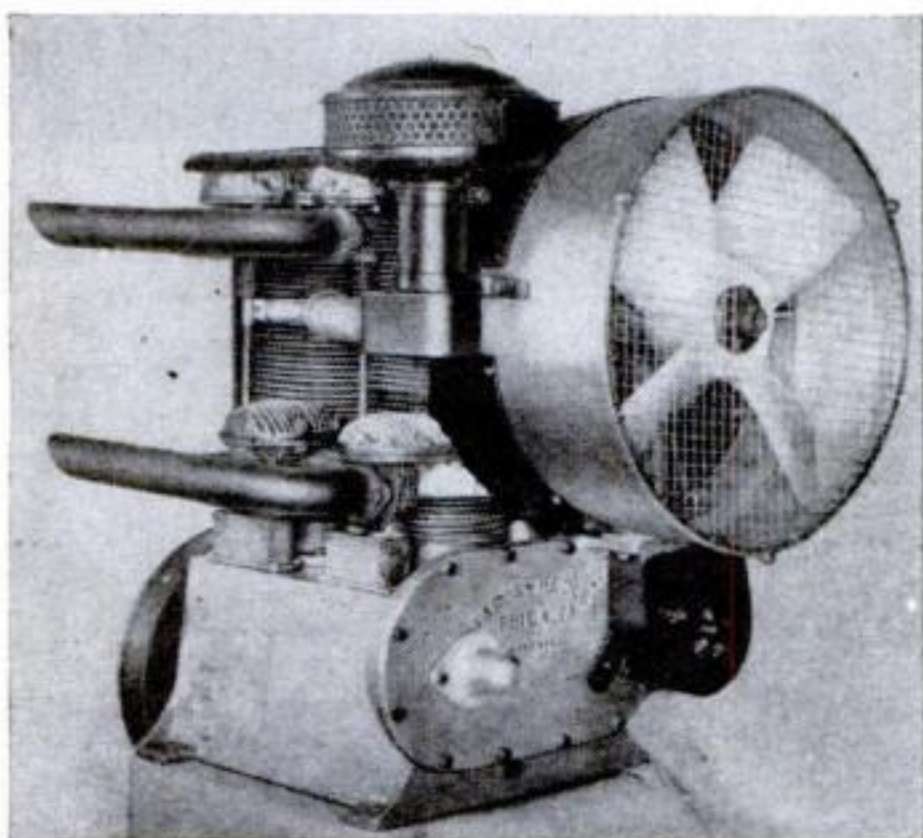


CONSTRUCTION

CONCRETE "CARTRIDGES," stronger and cheaper than steel and lighter than aluminum, promise a new structural material for buildings and dams. Compacted by vibration while damp, the concrete is piston-packed into thin metal shells surrounded by spirals of steel wire, which it puts under permanent tension, in the Northwestern University process. Mass production of columns, like the one at right shown under test, would conserve U.S. iron ore.



ENGINEERING



TWO CYLINDERS develop as much as 32 horsepower in this compact auxiliary engine for land, sea, and air. Burning gasoline, the power plant employs the double-acting principle in which floating pistons receive power impulses at both ends of a stroke. The cooling problem, called the bugaboo of engines of this type, has been solved by placing heat-absorbing fins on the inside of the hollow pistons and circulating carburetor-intake air about them. Proposed uses include starting engines for larger plants and powering fire-fighting installations.

ASTRONOMY

AN "ASTROPHANE," a device so named by its New York designer, Otto J. Russert, is a three-in-one instrument for schools and museums that combines a celestial globe, a miniature planetarium, and a training device for navigators of ships and planes. Stars of the first to fifth magnitudes, inclusive, appear in their proper places on the 16-inch glass globe. Turning a knob, as shown, revolves models of planets within the sphere to their configuration at any past or future date.



The Boy Who Built a Helicopter

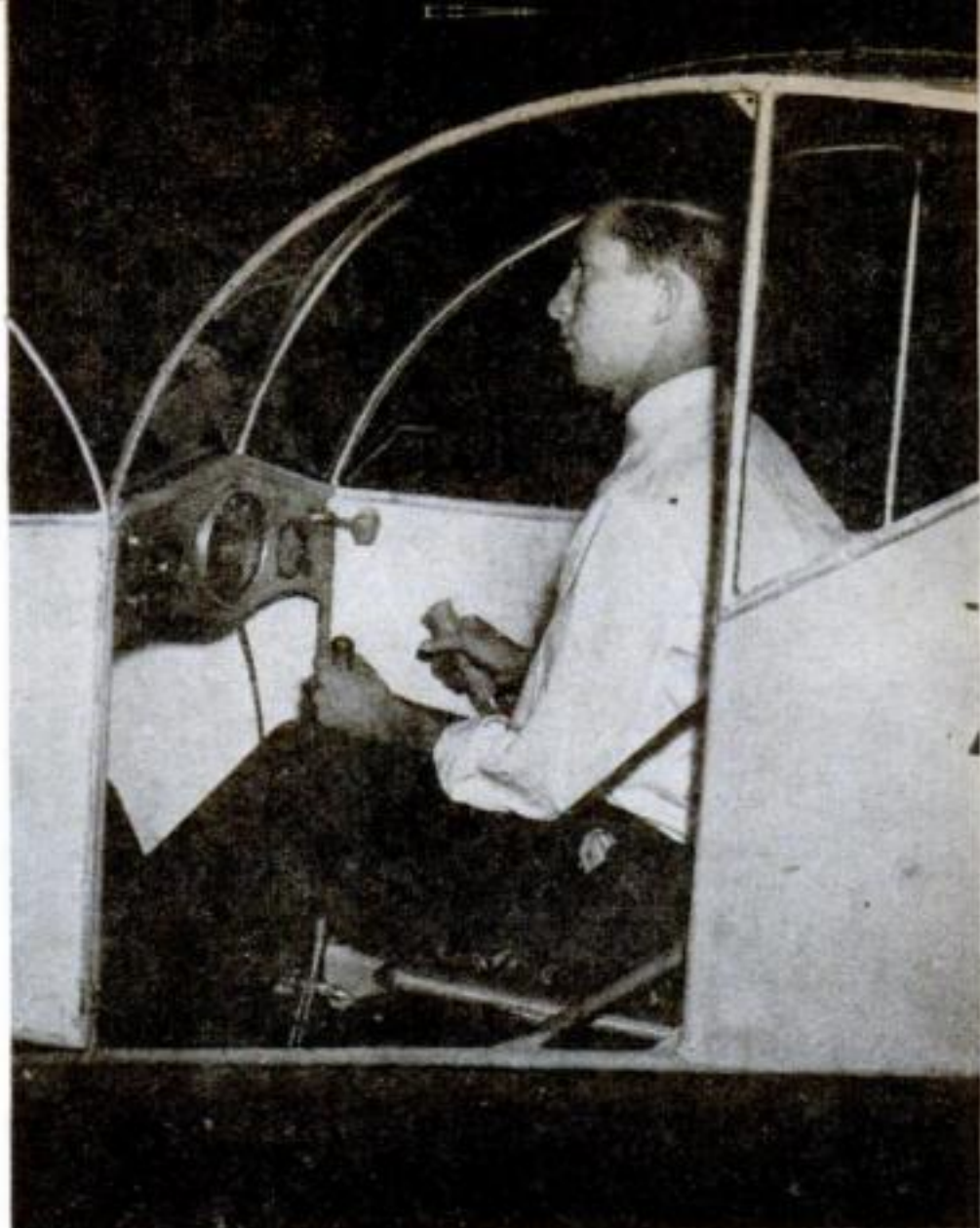
... and now Stanley Hiller is working for Henry Kaiser as a designer of postwar aircraft.

A 19-YEAR-OLD engineer, largely self-taught, has produced what may prove to be one of the world's best helicopters.

Lean, black-haired Stanley Hiller, Jr., of Berkeley, Calif., who headed a \$100,000-a-year business in model automobiles by the time he was 14 years old, is the designer of the machine. He calls it a "Hiller-copter."

It must be pretty good. The other day, one of America's leading industrialists, Henry J. Kaiser, the shipbuilding man, bought the manufacturing rights to it and "took over" young Hiller. The youngster was instructed to design other "Hiller-copters" for Kaiser Cargo, Inc., which is no mere side dish on the Kaiser menu.

Young as he is, Stanley Hiller is traveling in fast engineering company. He is a natural in mechanics. At 12 he was manufacturing model racing cars in the family

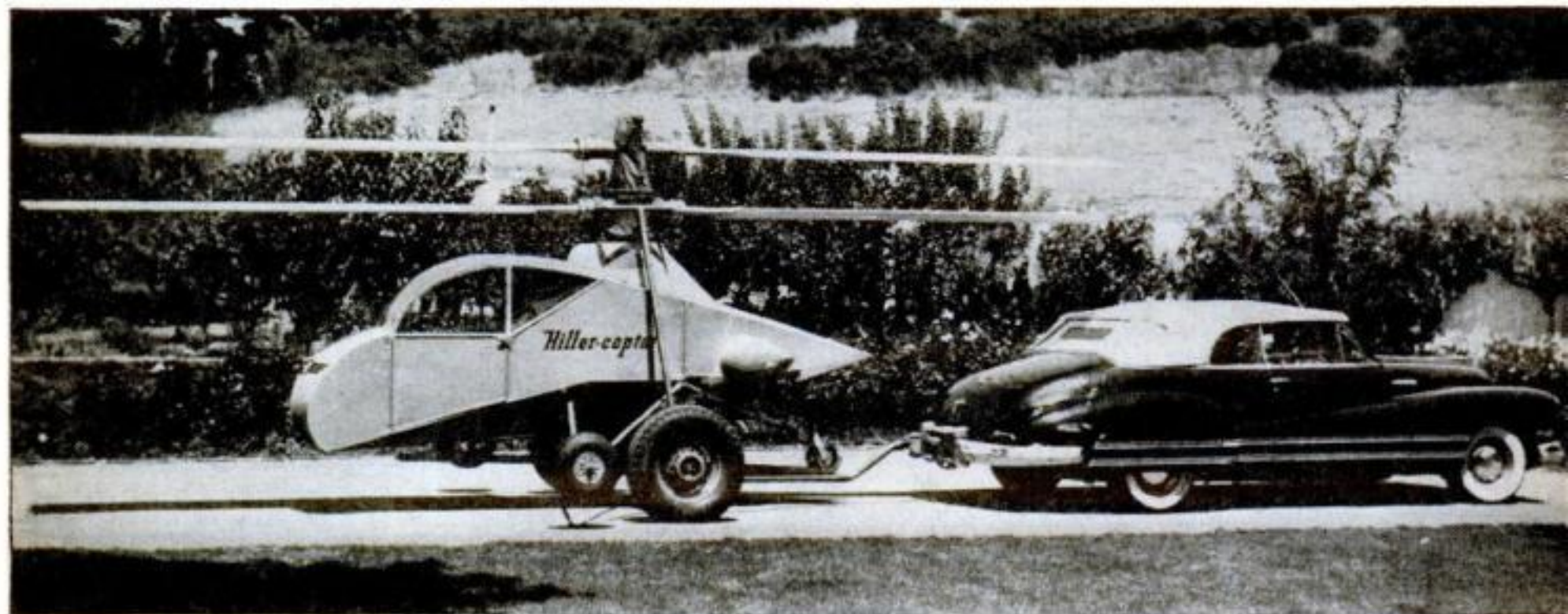


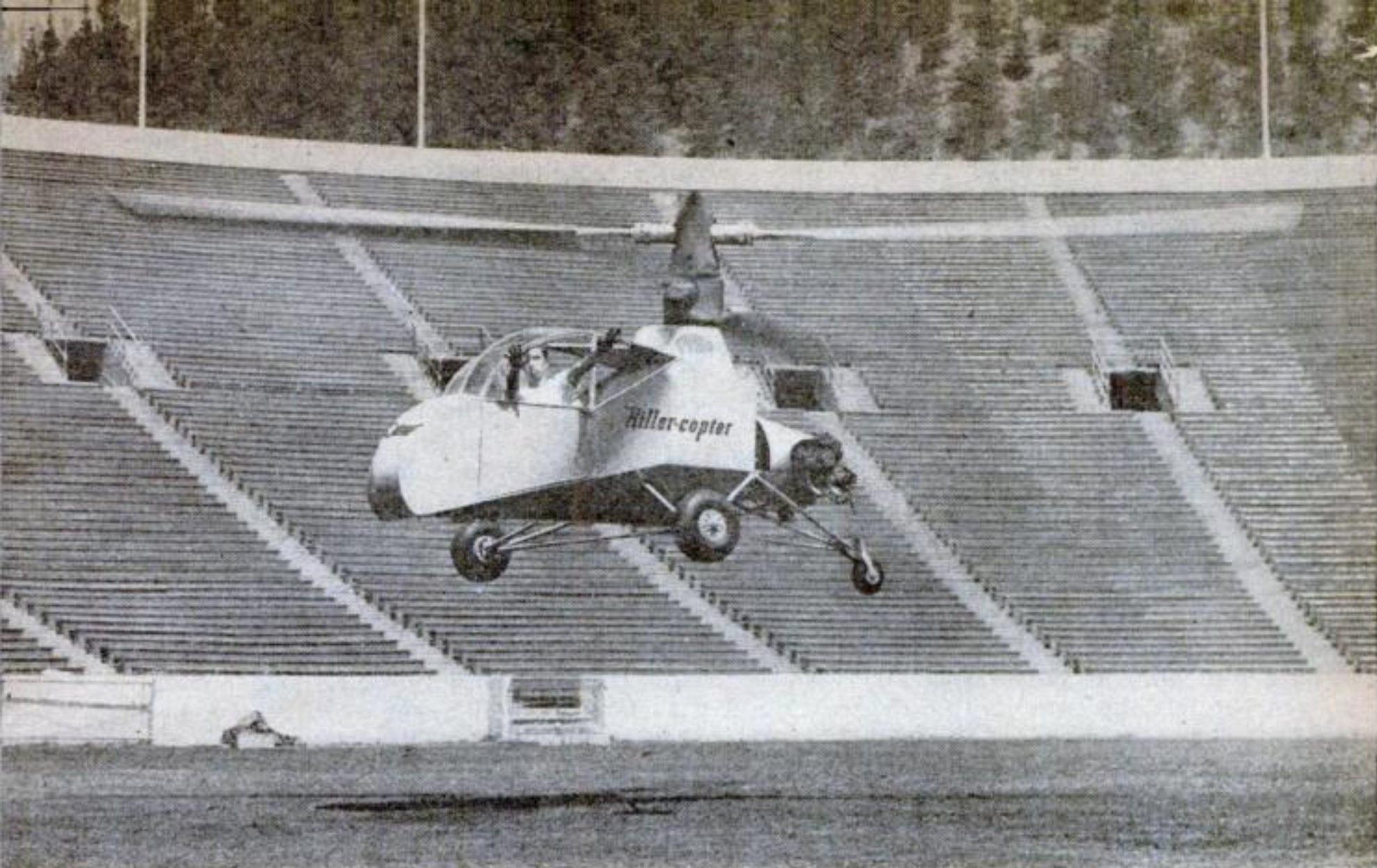
Stanley Hiller, Jr., at the controls of his "Hiller-copter." Note "clean" instrument panel

basement. At 14, expanding his model-car business to achieve assembly-line production, he was toying with helicopter flight. At 17 he demonstrated to the Army the mechanism that, he said, would make his helicopter work.

Helicopters began to intrigue him because of what he considered their mechanical imperfection. This "Henry Ford of the Midg-ets," as he is known for his manufacture of tiny cars fitted with fractional-horsepower gasoline engines, was puzzled because al-

Towing through city streets and along country roads presents no problem: ship is narrow and its rotors can be aligned along the horizontal axis. Airfoil section of each rotor blade is 10 feet long, 14 inches wide





NO HANDS! To demonstrate the craft's stability, the 19-year-old inventor lets go of the controls as the helicopter hovers in midair in a California stadium. Only flight controls are stick, rudder, and pitch lever

most all the designers of currently successful helicopters put a small propeller on the back ends of their machines.

Whirling in a vertical plane, it compensated for torque—the reaction set up by the canopy of blades overhead that impelled the fuselage to turn in the opposite direction. That wasted power, he reasoned.

So he began experimenting with two sets of blades, one above the other and turning in opposite directions. That would damp out the torque of that collection of lifting blades, called the rotor. It was Hiller's first fling at aeronautics. Characteristically, his friends say, he tackled one of the oldest and horniest of flying's problems. Men have grown gray trying to evolve a formula for rotating-wing flight.

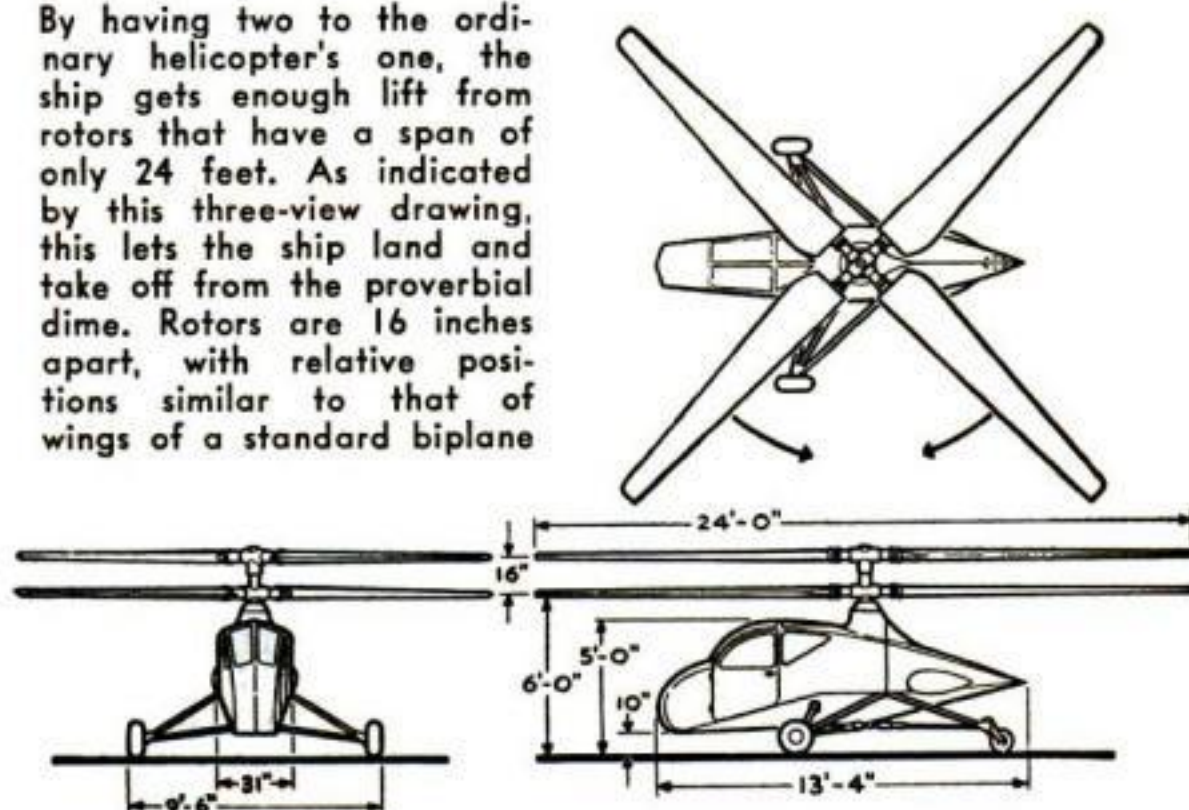
His idea wasn't new. By count—Hiller is nothing if not thorough—he found that 37 inventors before him had built helicopters with two rotors mounted in that fashion. They were called coaxial rotors. But almost all of these machines were dismally unsuccessful. Hiller set out to find out why.

His equipment in formal education was something

less than formidable. He had been to a college-preparatory school at Milford, Conn.—employing his time out of the classroom to pore through semi-technical magazines. It was here that he began studying helicopter flight. Back home his father and a plant manager kept his embryo model racing-car business going. Within a few months after returning to Berkeley in mid-1940, the boy was fabricating the cars at a rate of 250 a month.

Except for such items as spark plugs and magnetos, he manufactured the machines

By having two to the ordinary helicopter's one, the ship gets enough lift from rotors that have a span of only 24 feet. As indicated by this three-view drawing, this lets the ship land and take off from the proverbial dime. Rotors are 16 inches apart, with relative positions similar to that of wings of a standard biplane



complete, including a single-cylinder engine that kicked up one horsepower when it was pushed to 18,000 r.p.m. To young Hiller, designing and building that engine was a major job. To insure long wear, he cast the crankcase and differential as a single unit. He made the die, then designed a machine to run the die. This led to the development of another machine, to make strong aluminum-alloy castings by die-forging them. His castings were nearly as strong as steel and two thirds lighter.

He obtained a patent on that.

Nights and week ends he kept sketching helicopters.

Having demonstrated his business acumen, he elected to study engineering at the University of California. But helicopters kept plaguing him, and at the end of his freshman year he left the campus to do research work.

He needed space for free-flight experiments. So he set up a laboratory near his father's shipping company on the ninth floor of a San Francisco office building. There he experimented both with wing shapes and with a mechanism that would permit him to control the angle of the rotor blades in flight. It was a rare day when workers in adjoining offices didn't see one of Hiller's model helicopters drifting down the side of the building.

Again he exhibited his gift for scientific thoroughness. The performance of those models was photographed with both movie and still cameras.

It was a year before Hiller finally nodded his head to the draftsman who was helping him. He was satisfied with his wing shape (or airfoil section), with the mechanism intended to control the angle at which the blades attacked the air, and with the spacing between the upper and lower sets of blades.

The control mechanism was the heart of the matter. He knew that. So he built one to half scale and set off for the Army Air Forces Materiel Command laboratories at Wright Field, Dayton, Ohio.

Young Mr. Hiller was now all of 17 years old.

At Dayton he explained how his machine worked. He wanted suggestions. Just as important, he wanted help on priorities for a light aircraft engine to power his machine. The Army officers pursed their lips and rubbed their chins. Nope, they said, it wouldn't fly. The swept-disk area of the blades (the area covered by the blades in rotation) wasn't big enough.

"Those officers," he relates somewhat wistfully, "thought my machine would not fly."

That didn't stop him. He put the wraps

back on his device and caught an airliner straight to Washington. There he button-holed A. W. Lewis, head of the aircraft priorities branch of the War Production Board. He went to Grover Loening, aircraft consultant to the WPB and chairman of the rotary-wing division of the National Advisory Committee for Aeronautics.

He got what he wanted.

On a sunny afternoon last May the Hiller-copter made its maiden flight from the concrete driveway of his home. It wasn't a long flight. For safety's sake, Hiller had tethered the machine to the bumper of his automobile. The 'copter inched off the driveway, hovered, and settled back. Another hour of testing—with the machine still restrained by a cable—followed.

Now Hiller was ready for the big moment. Up to now he had never even seen a helicopter in free flight. Secretly he trundled his machine into the University of California's football stadium. There he climbed aboard, started the engine, and manipulated the controls.

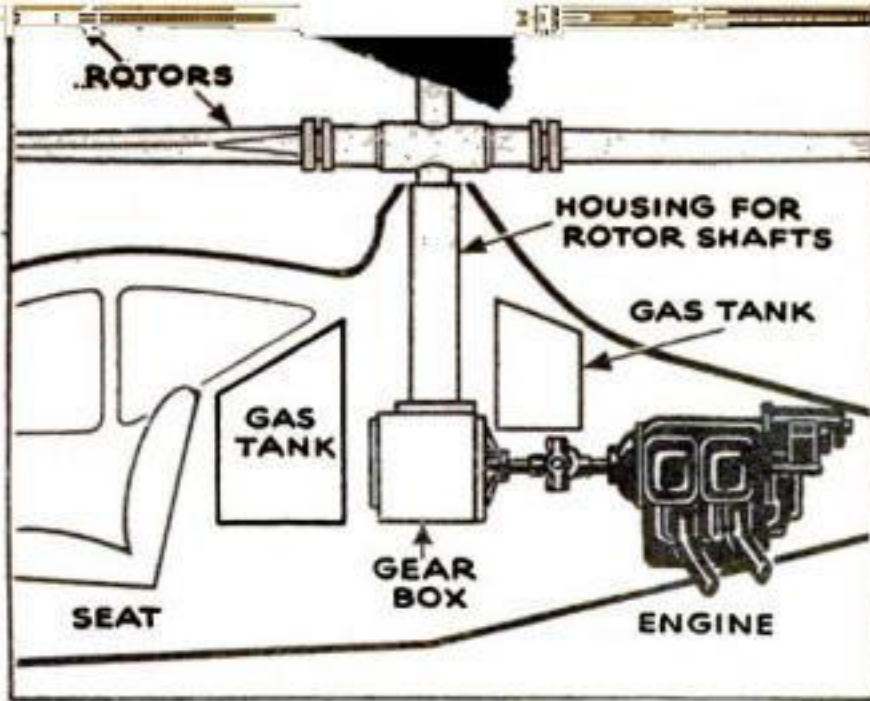
The Hiller-copter, unfettered, was a perfect lady. It climbed, turned, and gently came to rest on its tricycle landing gear at the will of the man in the cockpit.

Since that day it has put in a good many hours soaring over the stadium and the low hills near by. Hiller in one instance made a take-off from a San Francisco street. At no time has it been higher than 100 feet, but that's sufficient to prove that it can fly above the area of "ground effect," where air pushed earthward by the rotors buoys up a ship on the rebound. Sometimes helicopters will fly with benefit of ground effect, but no higher.

Ostensibly the Hiller-copter has departed no great distance from conventional rotating-wing aircraft with rotors of coaxial design. There have been other machines with coaxial rotors that were more or less successful. (P.S.M., June '44, p. 57.) The Hiller-copter carries a 90-hp. Franklin air-cooled engine, set aft to counterbalance the pilot's weight. It has a top speed of about 90 m.p.h. and has flown for as long as an hour and a half at a time.

A successful coaxial-rotored helicopter is something of a rarity because its design poses stupendous engineering problems. The more familiar helicopters have either balanced rotors set on outriggers to either side of the fuselage, or a single, big main rotor offset for torque by an auxiliary rotor on the tail. The prewar Focke-Achgelis machine is an example of the former and the near-famous Sikorsky VS-300 of the latter.

The Hiller-copter's two rotors, set 16 inches apart, revolve at 240 r.p.m. and describe a circle 24 feet in diameter. Each



Schematic drawing of the "heart" of the ship. The 90-hp. engine spins the rotors at an almost constant r.p.m. of 240, to produce speeds (controlled by blade pitch) up to 90 m.p.h. At right, Hiller inspects engine, which is mounted in the tail instead of under rotor mast, as in more familiar 'copters



rotor blade—there are two in each set—has an airfoil section 10 feet long and a uniform chord (an imaginary line drawn from the leading to the trailing edge) of 14 inches. Hiller estimates his total lifting surface at 46.66 square feet.

As in some other helicopters, the blades can be feathered individually or as units for lateral, directional, and longitudinal control. In addition Hiller can vary the pitch of the blades in one rotor without affecting those in the other rotor.

Ascent and descent are achieved by varying rotor pitch and engine speed. Horizontal flight depends on increasing the pitch of each blade as it wheels through one segment of its circle, and decreasing the pitch as it reaches the opposite segment.

Hiller's control Mechanism design is secret.

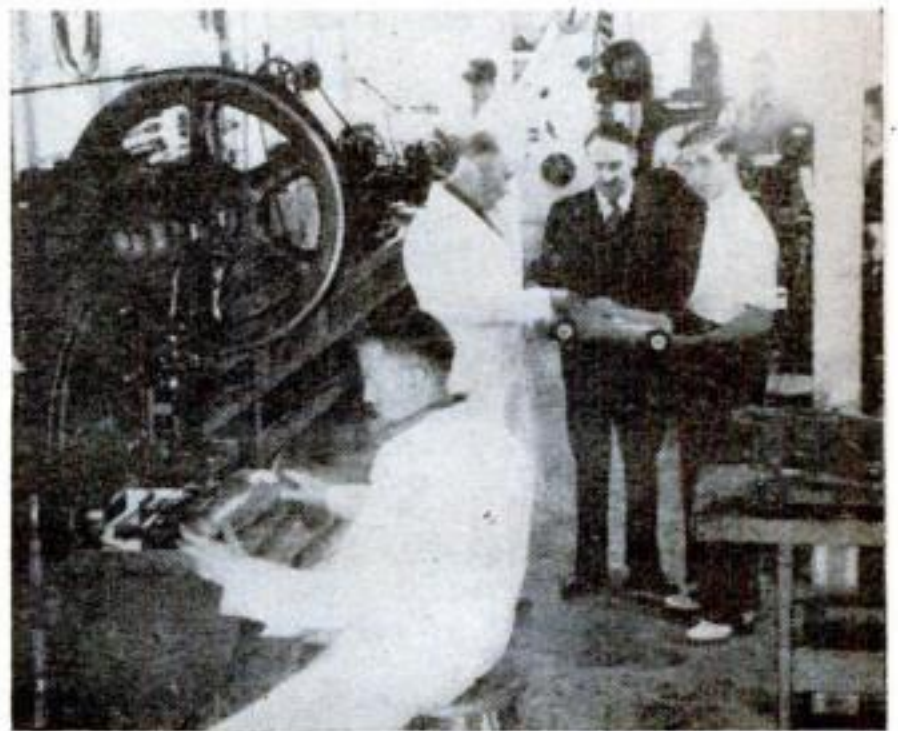
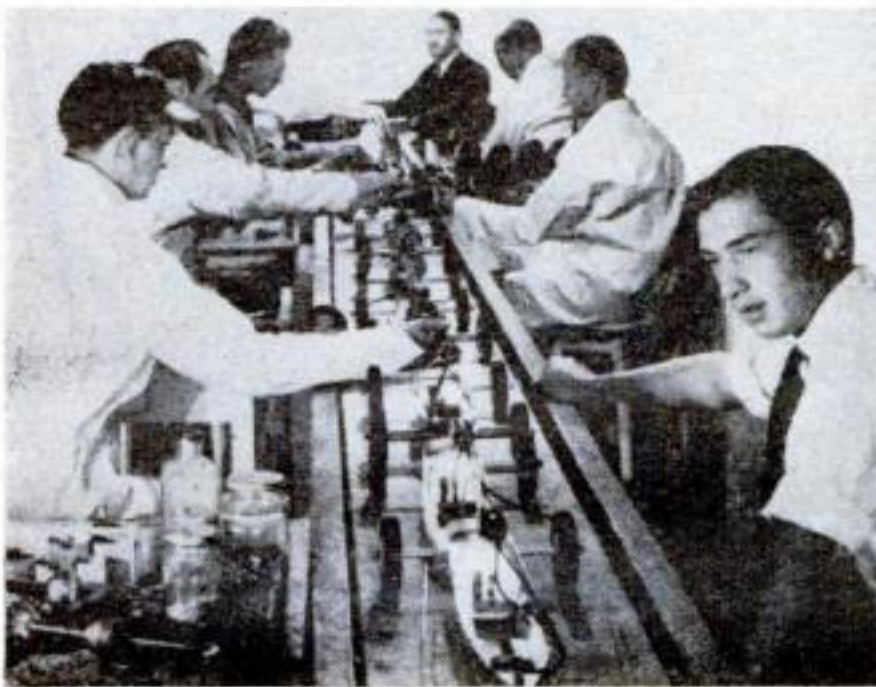
What distinguishes the Hiller-copter from

other coaxial machines, according to those who have seen it fly, are a lack of vibration and the ease with which it can be flown.

The XC-30033, as Hiller calls it, is purely an experimental machine of fabric-covered steel tubing. From the front the fuselage resembles the snout of a sea elephant. The cabin is enclosed, above shoulder height, with transparent plastic, giving vision all ways except straight down.

Hiller has two new designs on his drawing board. One is a two-passenger ship for carting persons and baggage short distances from air-line terminals. The other, bigger, is intended to cruise for hundreds of miles and, if necessary, to do emergency work at sea. It can be fitted with three stretchers.

The young inventor reads voraciously. Included in his library is a complete file of *POPULAR SCIENCE MONTHLY* since 1928.—ANDREW R. BOONE.



Hiller broke into engineering at 12 by making gas-driven racing-car models. At 14 he had an assembly-line plant (above) that was doing a \$100,000-a-year business. At 17 he had developed the Hiller-copter. Now, at 19, both he and his remarkable ship have been "taken over" by Henry J. Kaiser as a "subsidiary"

The B-29 Brings A New Era In Bombing

An Intelligence officer of the global Twentieth Air Force tells how "engineered flight" makes the big Boeing bombers one of Tokyo's main headaches.

By MAJ. SELBY W. CALKINS
As told to DEVON FRANCIS

WE WERE sweating. We knew that 1,500 miles away a task force of B-29 bombers was—or ought to be—pounding Japan.

For months we had been saying that the Superfortresses would reach their target at a moment that could be predetermined right there at the Twentieth Bomber Command operations office in interior China. That was

how the B-29 had been built. That was the operational technique that we were using on this first raid on the Japanese homeland.

But now, as we sat in a shack with blacked-out windows in that hot, humid China night, the time had come—and the squawk box connected with Radio was mute. I glanced at my wrist watch to make sure. It was 11:55 p.m., China time.

Waiting with us were Maj. Gen. George E. Stratemeyer, commanding the Army Air Forces in the India-Burma sector, and, of course, Brig. Gen. K. B. Wolfe, commanding general of the Twentieth. Flanking them were the high-ranking officers of their staffs.

For hours we had been plotting the assumed progress of the bombers, maintaining strict radio silence, toward their target, the Yawata steel works on the island of Kyushu. Inside the bamboo-and-mud structure that served both as an air room and, during a raid, as an operations office, we had tacked maps on the pine-sheathed walls. On those

AS HEAD of the A-2 (Intelligence) Section in China for the Twentieth Bomber Command, Major Calkins participated in two Boeing Superfortress raids. In the first strike at Anchan, the code word for "Bombs Away" in the bombardment group with which he rode was "Judy," the name of one of his small daughters. Judy is a flyer herself, having piled up 250 hours in the air with her father before she was three.



Maj. Selby W. Calkins



Judy makes believe she's sewing up a B-29

WAR DEPARTMENT
Bureau of Public Relations
PRESS BRANCH
Tel. - RE 6700
Brv. 3435 and 4860

IMMEDIATE

June 16, 1944

RELEASE

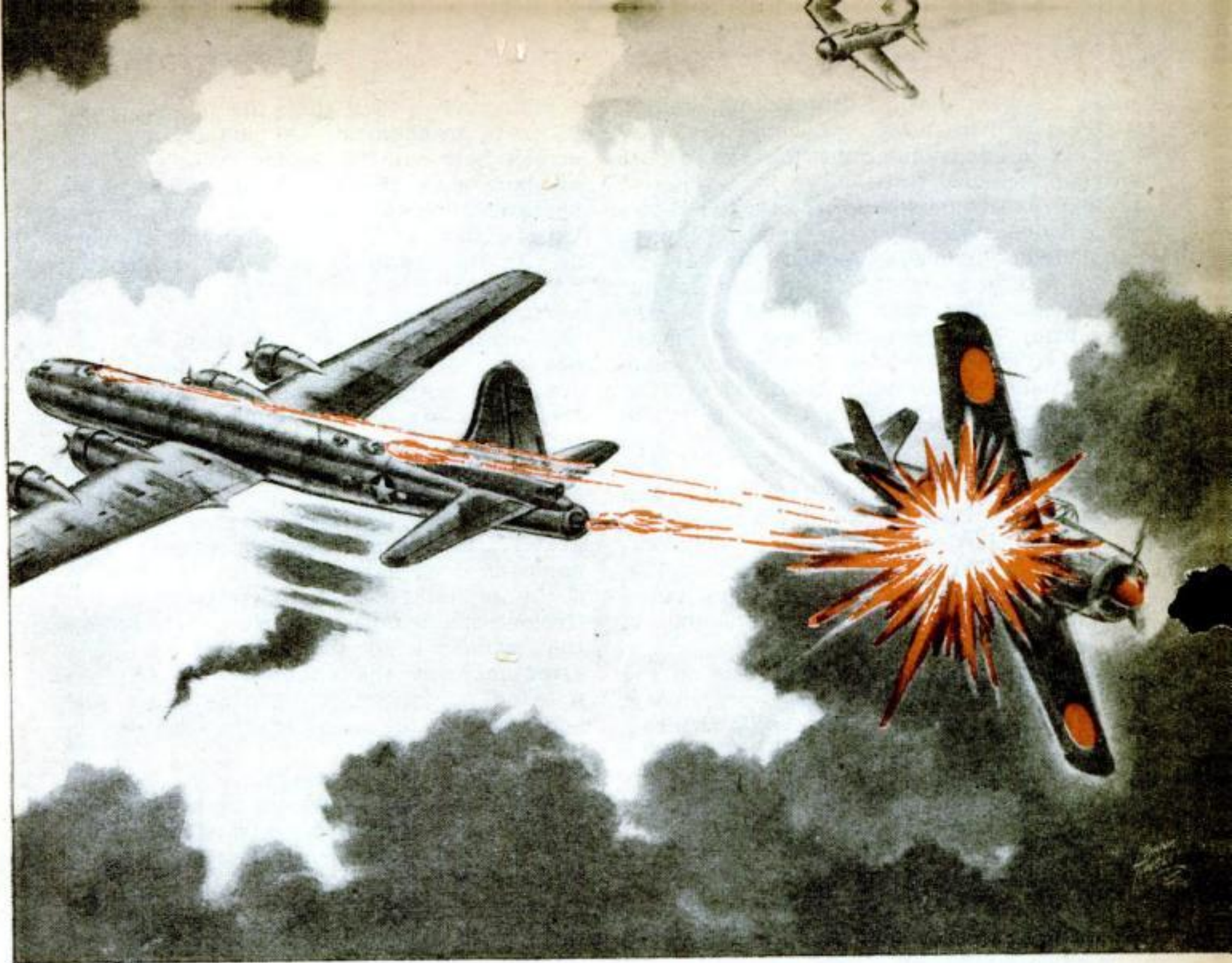
HEADQUARTERS, TWENTIETH AIR FORCE. COMMUNIQUE NO. 1.
A sizable task force of B-29s from the Twentieth Bomber Command bombed industrial targets at Yawata on Kyushu Island in the Japanese homeland on Thursday, June 15.

Preliminary reports reveal that although enemy aircraft were encountered and antiaircraft was moderate to intense, none of the planes was lost as a result of enemy action. Fliers who participated in the mission report the bombing was accurate and that large fires and explosions were observed.

The planes operated from bases in China which were completed recently. Two B-29s were lost as the result of accidents, one crew of which is safe. This communique is based on preliminary incomplete reports from the combat zone.

END

HISTORIC DOCUMENT. This terse announcement, Twentieth Air Force Communique No. 1, told the world that the B-29 had tasted blood in its first actual raid



FIREPOWER of the Superfortress is the bane of the Jap interceptor fleets. Repeatedly, Nip fighters have swarmed in upon one or more B-29's, only to discover that it was a short cut to hara-kiri. The only complaint you hear from the Superfortress gunners is over the scarcity of targets. In the drawing above, P.S.M. artist Frank Tinsley has graphically illustrated the terrific gun punch packed by the big bombers

FORTRESS AND SUPERFORTRESS. Below is a comparison of the B-29 with its little (but older) brother, the Boeing B-17 Flying Fortress. The plane at lower right is a Superfortress; the two others, B-17's. A little study in perspective will show the comparative size. The nearer B-17 is much closer to the camera than the B-29. Note the latter's longer nose and relatively narrow chord of its wing



maps we were continually marking crosses.

"They're here now," we would say. According to our calculations, that was where the bombers had to be.

They had to be there, because the B-29's were being flown by slide rule. We were introducing engineered flight to air warfare. There was to be no throttle-pushing in our operations. The man who had done the estimating on target time was Burton H. Burns, a Texan. Now a lieutenant colonel, Burns had won so many decorations flying in the Southwest Pacific that after he got to China the "fruit salad" for his blouse was still catching up with him.

I glanced at Burns' pink face. He looked unconcerned. Burns came by his poker face naturally. He departed the Southwest Pacific with \$3,000 that he had made by filling inside straights, and once in Honolulu he won his commanding officer's automobile in a crap game.

His admiration for the Japs was on the faint side. "They've got tails," he would say.

"The lead plane will break radio silence," Burns had forecast, "at 23:55." That was 11:55 China time.

But it was target time now.

"Shouldn't we be hearing?" asked General Wolfe. The question was rhetorical.

I strolled over to the map and started drawing a picture of a bomb over the target. Nobody was saying anything. It took me a long time to draw the picture. I meant it to.

Suddenly the squawk box came to life. "Radio to A-2," it blatted. Nobody breathed. "Bombs away signal at 23:58."

We were three minutes off our estimate.

Engineered flight would work. We had proved it. Subsequent raids added to the evidence.

It worked because the B-29 Boeing Superfortress is an airborne battleship in miniature. The Army describes its raids as "task force" strikes. At his spacious desk sits the flight engineer, one member of the 11-man crew. He knows, and the pilot and

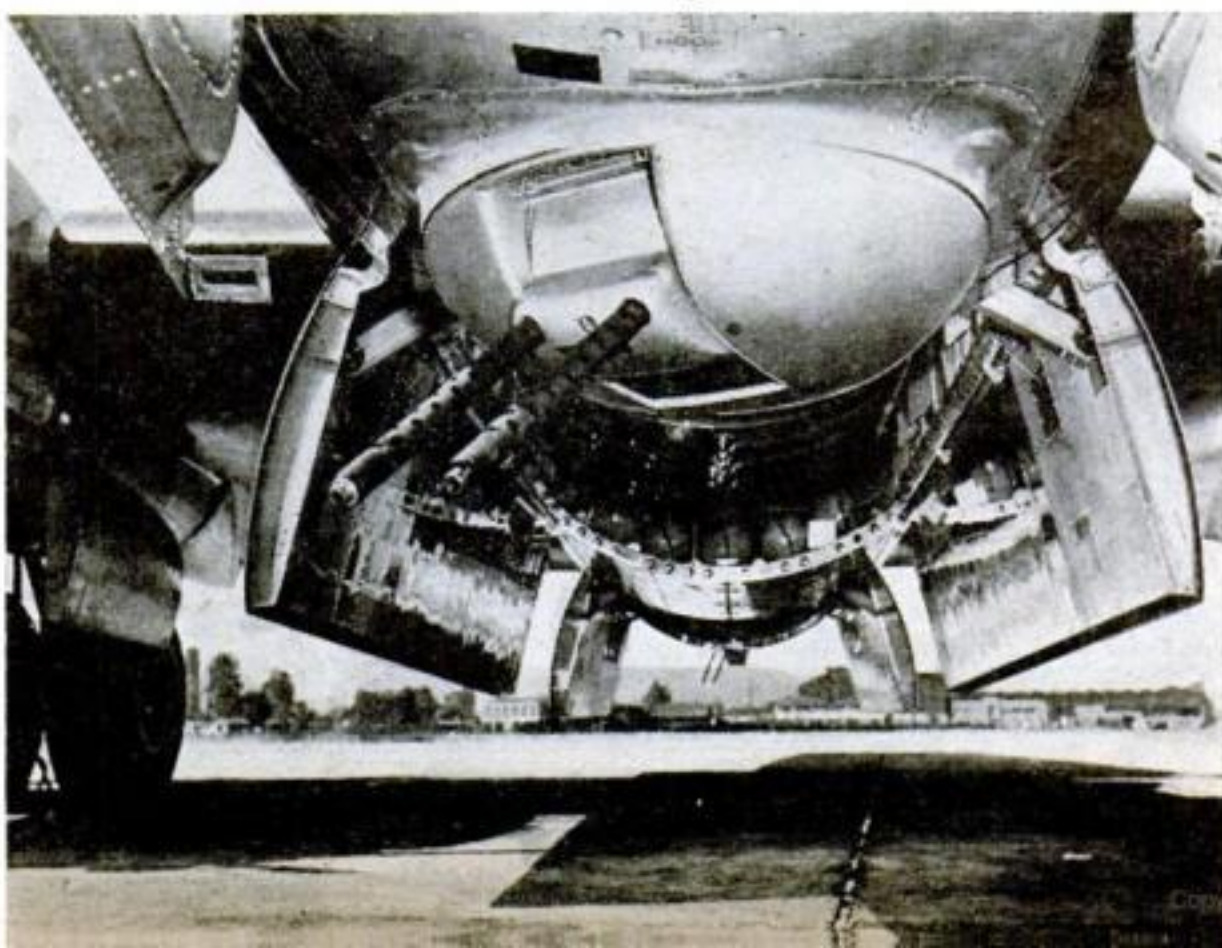
copilot know, that they are handling an intricate mechanism. A balance must be struck between the loaded weight of the airplane and the speed at which it is operated to obtain maximum flying range. On his curve of power output the engineer selects the manifold pressure and engine revolutions to obtain the highest "permissible brake mean effective pressure" inside the cylinders. He makes that selection not once but dozens of times during the course of a flight as fuel is consumed and the bombs are dropped and the weight of the airplane lessens.

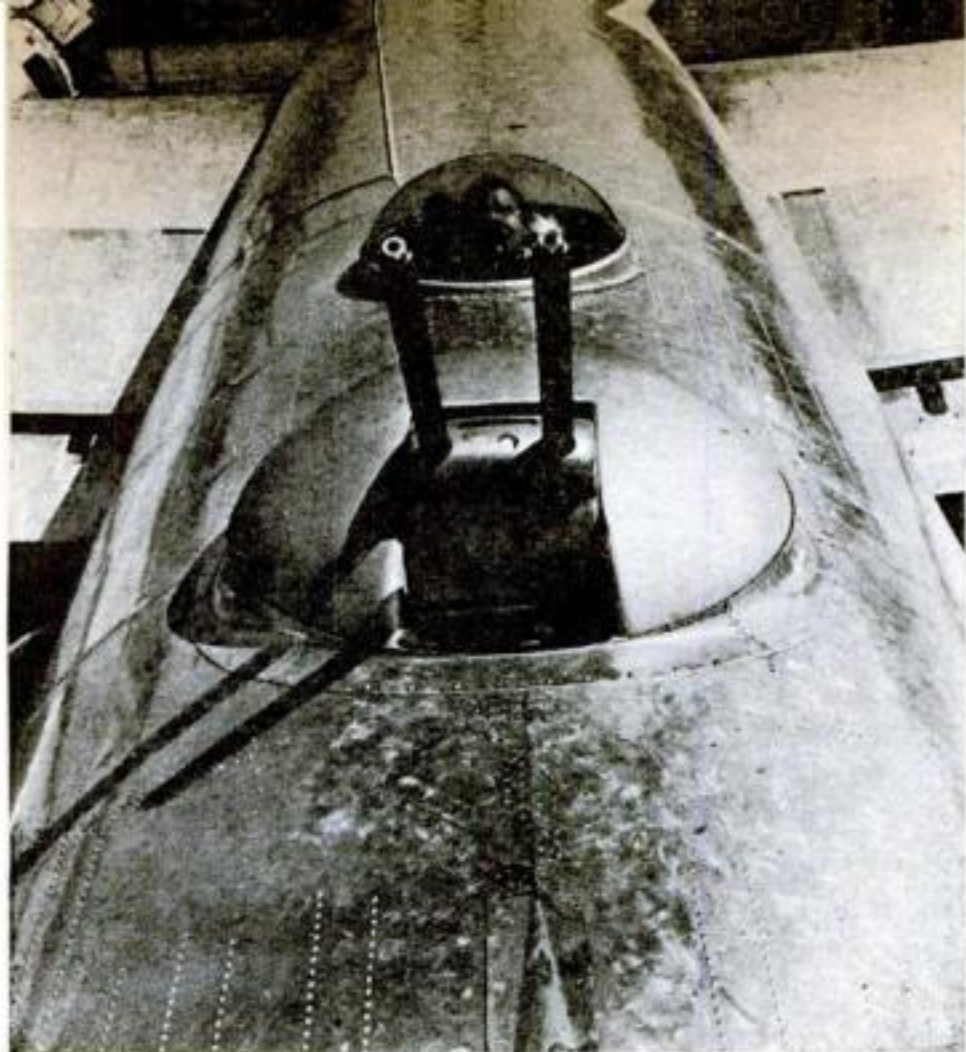
Between the pilot and the engineer runs a constant interchange of information on the intercom. What is the present center of gravity, the proper cruising speed? Perhaps the cowl flaps, governing the flow of air around the four 2,200-horsepower Wright Cyclone engines, need adjustment to reduce the cylinder-head temperatures. At any given moment the engineer can tell the men on the "front porch" the exact fuel consumption of each of the engines in pounds per hour.

He controls the settings for mixing fuel and air. He starts an auxiliary gasoline engine to provide added electrical energy for take-offs and landings. He governs the super-



Here you are looking through a tunnel formed by the opened doors of the two bomb bays of the B-29. The two .50 caliber machine guns seen in the forward belly turret are remotely controlled like those in the four other positions indicated on the large photograph above

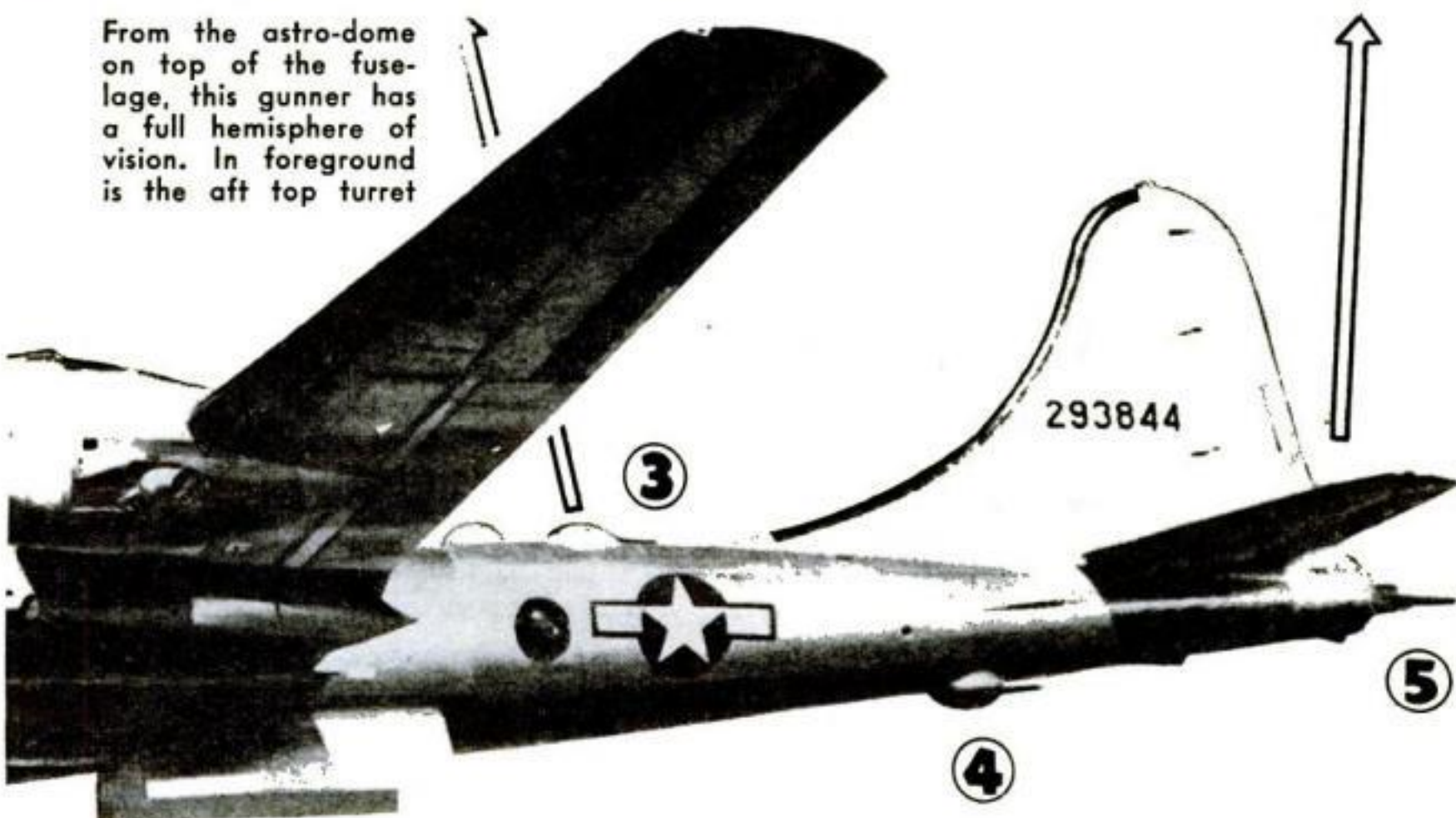




From the astro-dome on top of the fuselage, this gunner has a full hemisphere of vision. In foreground is the aft top turret



"Tail-end Charlie" is always the last man home. In his "office" under the rudder he controls the two .50 caliber machine guns and one 20-mm. cannon that make this one of the best-protected spots on a B-29



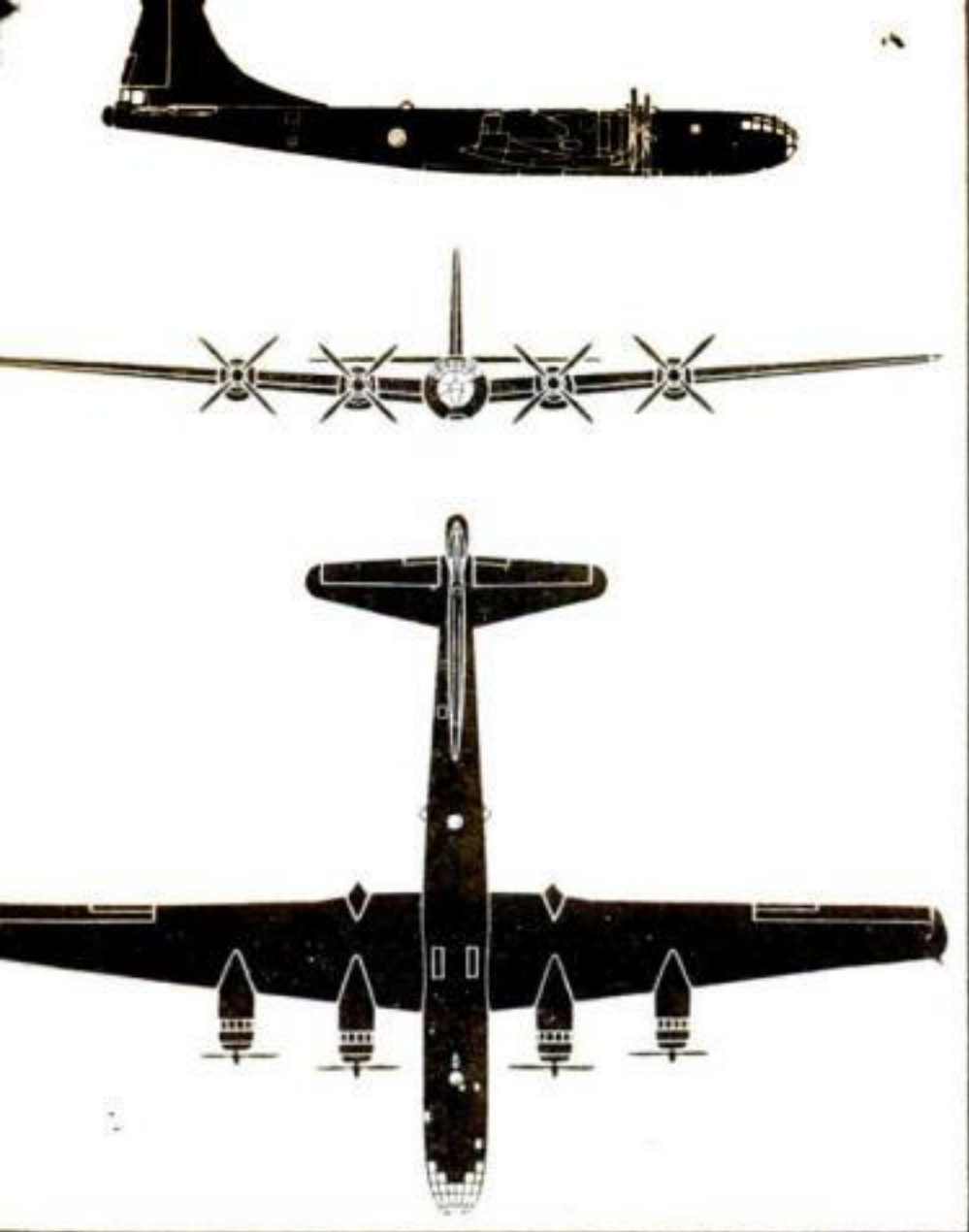
GUNS, GUNS, GUNS. This officially approved picture discloses for the first time the locations of the remotely controlled multiple-gun stations on the Superfortress. The B-29 is not the most heavily armed of Allied bombers; some others, toting more and bigger guns, are employed literally as flying artillery on tactical missions. The Superfortress IS the best gunned of all the strategic bombers

charging of the fuselage interior so that the crew can work at a simulated altitude of 8,000 to 8,500 feet while flying at 30,000 or above.

More engineering has gone into the B-29's two bomb bays than ever before went into the belly of an airplane. In them are stored anything from block-busters to 25-pound incendiary clusters. The B-29 can carry these missiles in whole or in combination. The bombardier can play on his shackle releases as a musician plays on the keys of an organ. Under normal conditions the bomb load is double what the B-17 Flying Fortress

can carry by filling its bays and hanging bombs from the wings for short-range operation.

In terms of crew efficiency, supercharging the fuselage finally has rendered high-altitude bombing as precise as a laboratory study. Crews of the bombers that blasted away at Germany for almost four years prior to the invasion often came home with fingers, faces or toes frozen. The interior of the B-29 is so warm and comfortable that crewmen seldom have to don even as much as a leather flying jacket. More than one pilot, sitting in the "greenhouse" in



KNOW THE B-29. This three-view drawing shows the family resemblance to the Boeing B-17, which was originally designed almost a decade ago

the sun, has shed his shirt to keep cool while the outside thermometer registered well below freezing.

Just as the B-29 was engineered for slide-rule flight, so was it designed for slide-rule combat. An evaluation of the airplane as a superb means of transportation for explosives and as a weapon to sluice those explosives accurately onto a target must be back-dropped by a description of the job it was built for.

The Superfortress is a strategic bomber. It is being used on Japan in the same fashion that the Flying Fortresses, Lancasters, and B-24's were used on Hitler's Europe. The swift march of Allied soldiers into Germany was accelerated by the smashing of Nazi oil-producing centers and of factories making machine tools, ball bearings, synthetic rubber and fuel, and railroad rolling stock.

In East Asia the task is far bigger. The

distances are more than twice as great. Japan's economic empire is far richer. In Europe, Axis industry was within Allied bombing range from the beginning. In Asia we are only now getting within range to erode the sources of Japan's industrial ability to make war.

We are within range only because the B-29 was built with twice the radius of action of the B-17. The Japs say we are basing the Twentieth at Chengtu, Szechwan province. If that is true, we are flying round-trip missions of 3,000 miles in striking at Nagasaki; we are flying 2,600 miles to hit Anchan, Manchuria. A known yardstick of the Superfortress' range is the round-trip distance from India to eastern Sumatra—more than 3,600 miles. Planes based with the Southeast Asia Command struck the Pladjoe refinery at Palembang, Sumatra, the enemy's largest source of oil, on August 10.

And the B-29 can fly farther than that.

As a weapon, the airplane is largely self-contained. It employs its own operational techniques.

After one raid the Jap radio commented: "Each man (pilot) flew in a direction to his own liking, at his own convenient altitude, and when the enemy planes withdrew it was done according to each man's fancy."

That was correct. Above their base after take-off the B-29's made rendezvous in elements of four. In elements of four they flew to their target. To bunch them in squadrons of 18 to 27 like the B-17's, to require large numbers of the ships to keep jockeying for places in a formation, would cost fuel. Sometimes, as in any other bombing operation, planes have to turn back short of their target. Sometimes planes have to go into the attack singly.

But I have yet to run across a Superfortress crew that is apprehensive over the loss of supporting fire from other planes in its element. The men of the B-29's know they can throw enough lead for their own defense. The system of fire control insures that.

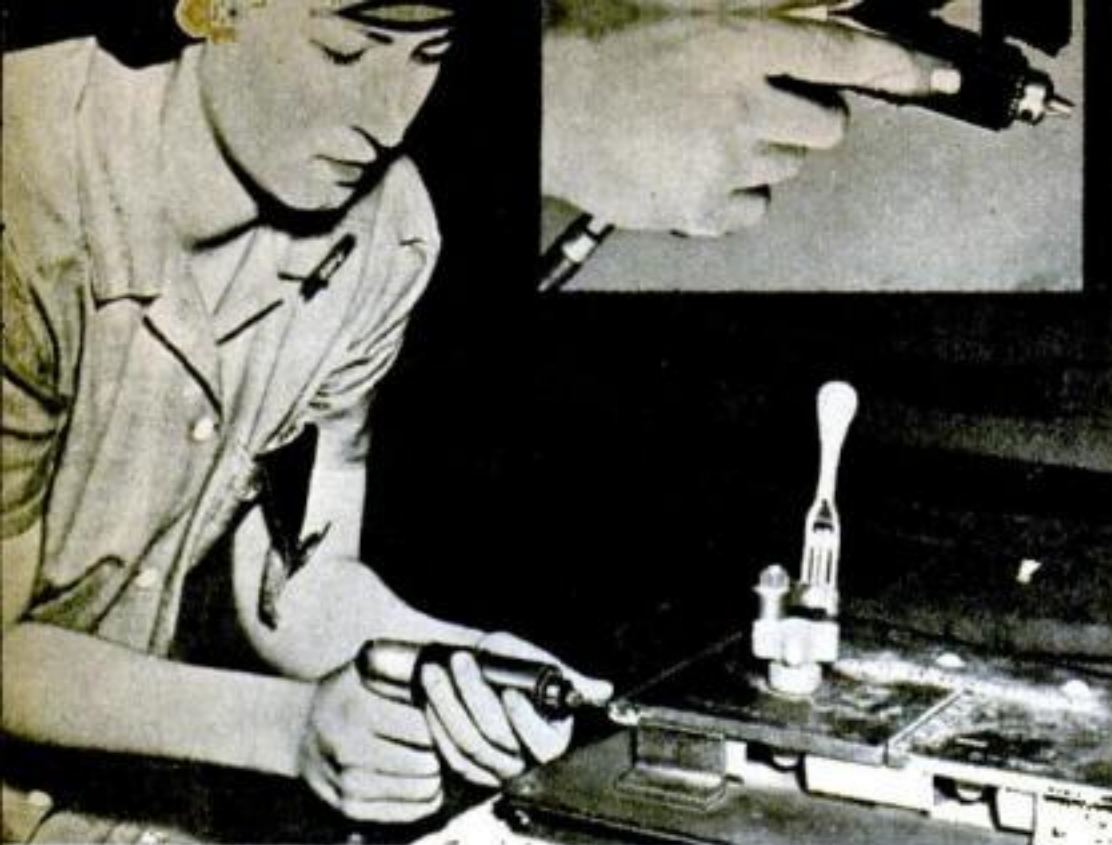
There is no point on the airplane that an enemy fighter could attack without flying into the muzzles of at least two .50 caliber guns, and in the course of his attack he will run into multiples *(Continued on page 222)*



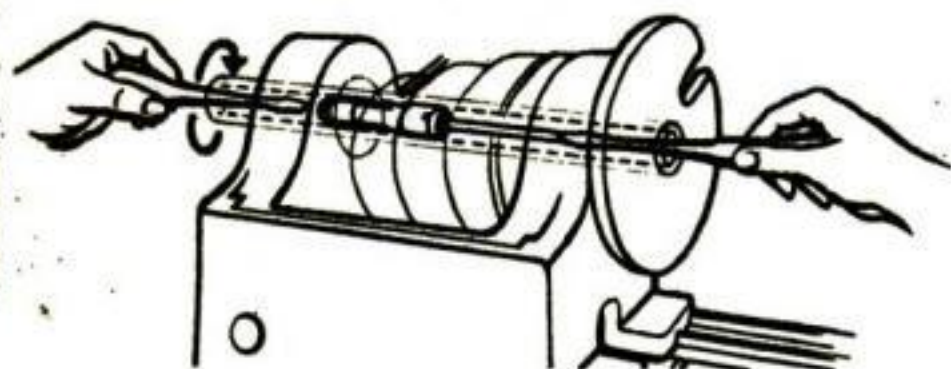
BOEING B-29 SUPERFORTRESS

Here Jo Kotula's brush has captured the sleek lines of the Superfortress, the weapon of our global Twentieth Air Force. Note the perfectly round fuselage, designed for high-altitude supercharging. Fairings of inboard engine nacelles stick out beyond trailing edge of wing. The B-29 is 98 feet long, has a wing spread of 141.2 feet. Four 2,200-hp. Wright Cyclone engines drive the giant





TO SHIELD THE CHUCK of the lightweight pneumatic drill made by Ingersoll-Rand Co., New York, a collar has been designed to protect the user's hand while enabling him to guide the drill easily and accurately. The whole outfit weighs only two pounds, but is sturdily built for three-shift endurance.



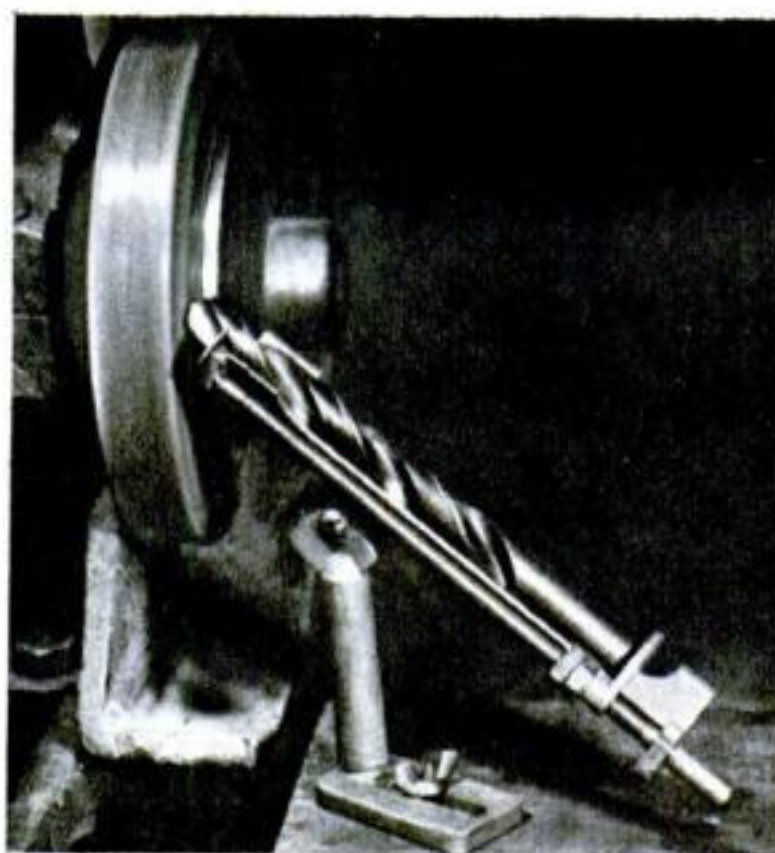
EXPANDING COLLET ACTION locks this stop in the hollow spindle of a lathe for locating repeat work. The Rieger Spindle Stop is set by two screwdrivers. It has a $\frac{1}{8}$ by 4-inch extension to limit hollow work and to protrude into the chuck for stopping short pieces.



new tools



RECOIL PRESSURE of springs up to seven inches long is measured by this new coil spring tester and torque wrench made by the New Britain Machine Co., New Britain, Conn.



SHARPEN THAT DRILL. Here is an inexpensive new drill-grinding attachment, made by the Crandall Manufacturing Co., Los Angeles, Calif., that holds long, short, and medium twist drills from $\frac{1}{8}$ to $1\frac{1}{8}$ inches in diameter.

ELECTRICAL MAGNIFICATION enables the new DoAll comparator to accomplish what formerly required four instruments. Three models made by Continental Machines, Inc., measure variations from four one-thousandths to 400 one-millionths of an inch.

BIG TOM THUMB

HOW MODEL MAKERS BUILD THEIR OWN AMAZINGLY REALISTIC LITTLE REPLICAS OF CIRCUS WAGONS, TENTS, AND SIDE SHOWS

By JEAN ACKERMANN

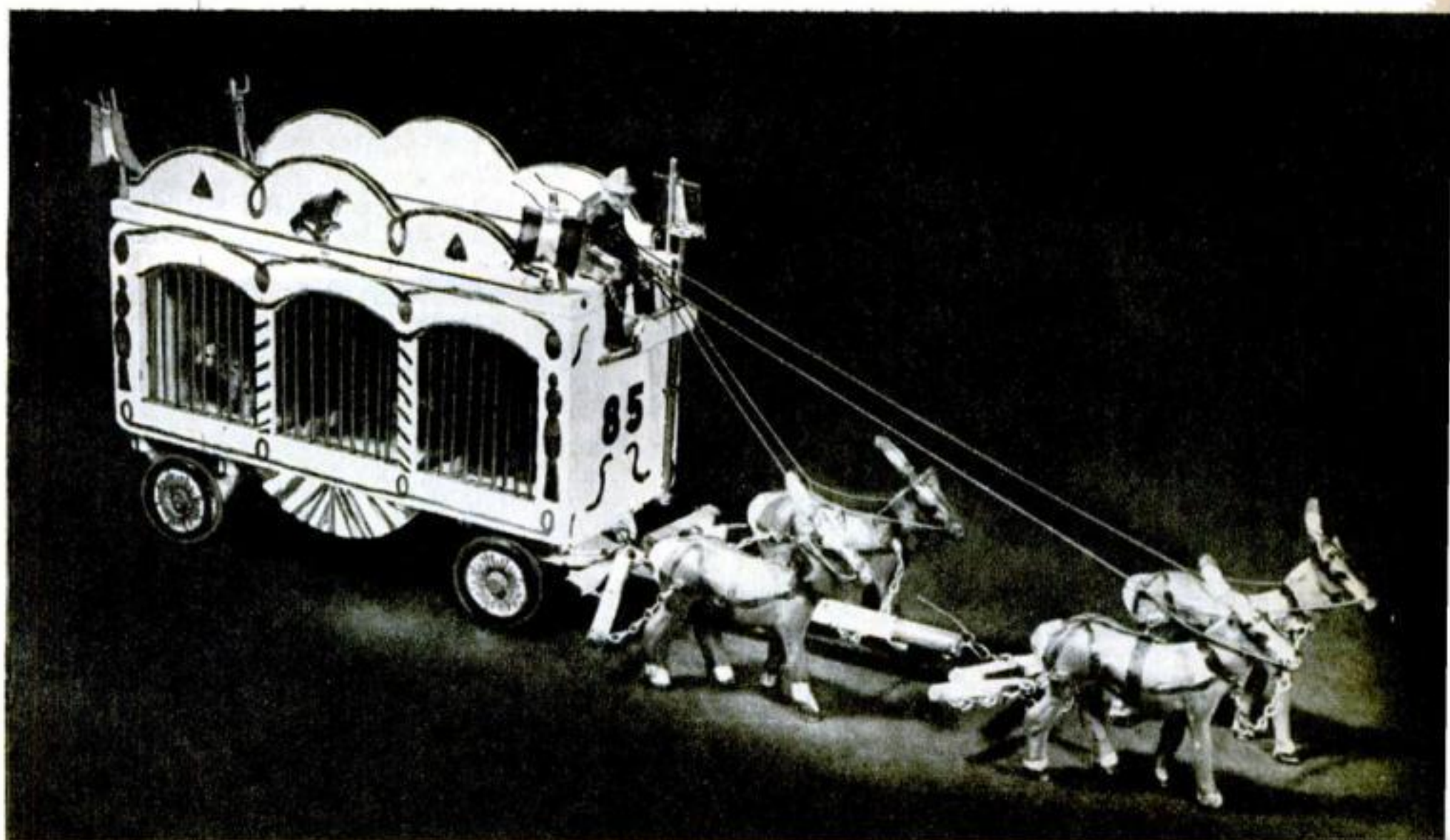
EVERYTHING about the circus except that heady, nose-wrinkling aroma is faithfully reproduced in miniature by members of the Circus Model Builders and Owners Association. This organization is a group of craftsmen who are young-hearted enough to thrill to the lure of lions 'n tigers 'n everything, and sufficiently skilled to dramatize their interest in the table-top circuses they are building. They may be farmers, mill hands, schoolboys, or business men. The hobby is highly specialized, so there are few blueprints available, and the fans have to go after their own data. When the circus comes to town, any conscientious modeler gets up before dawn and goes out to greet the troupe, lends a hand with the properties, and spends a day of sheer glory, measuring wheel spokes and elephants' trunks, and reveling in the backstage talk

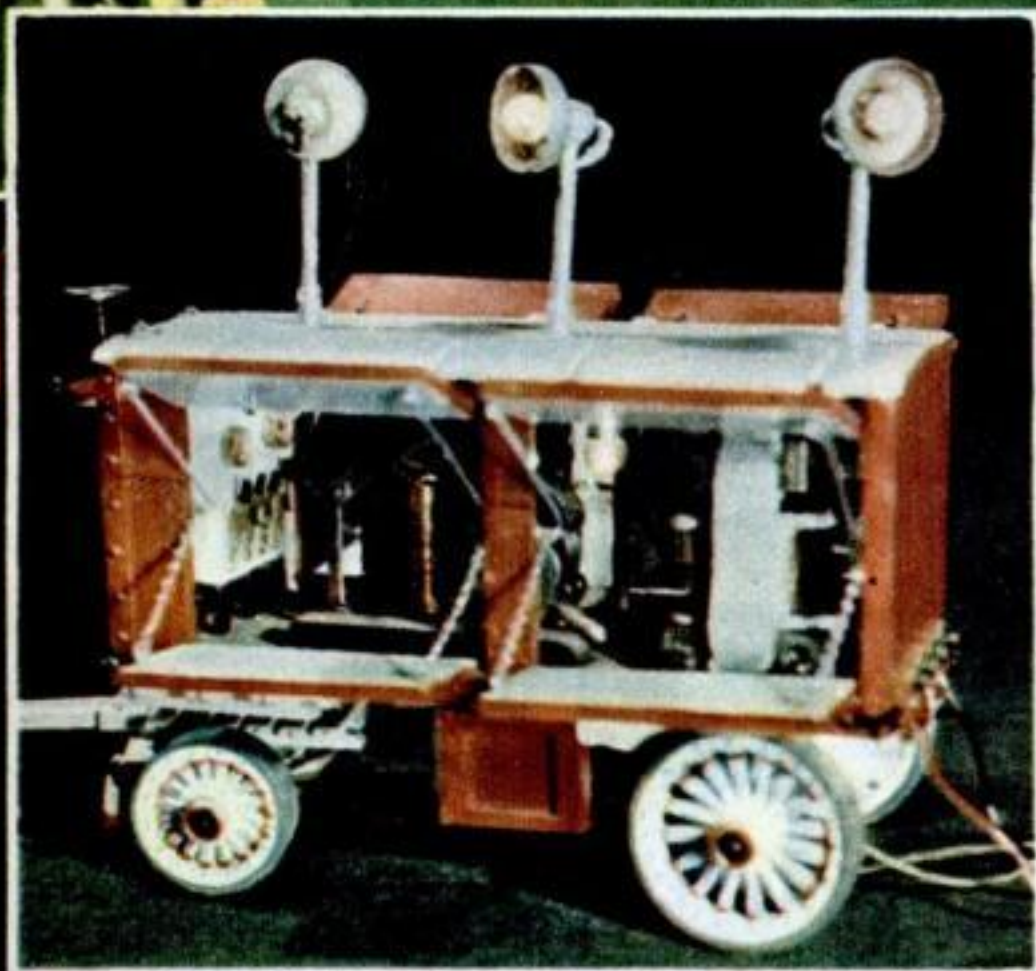
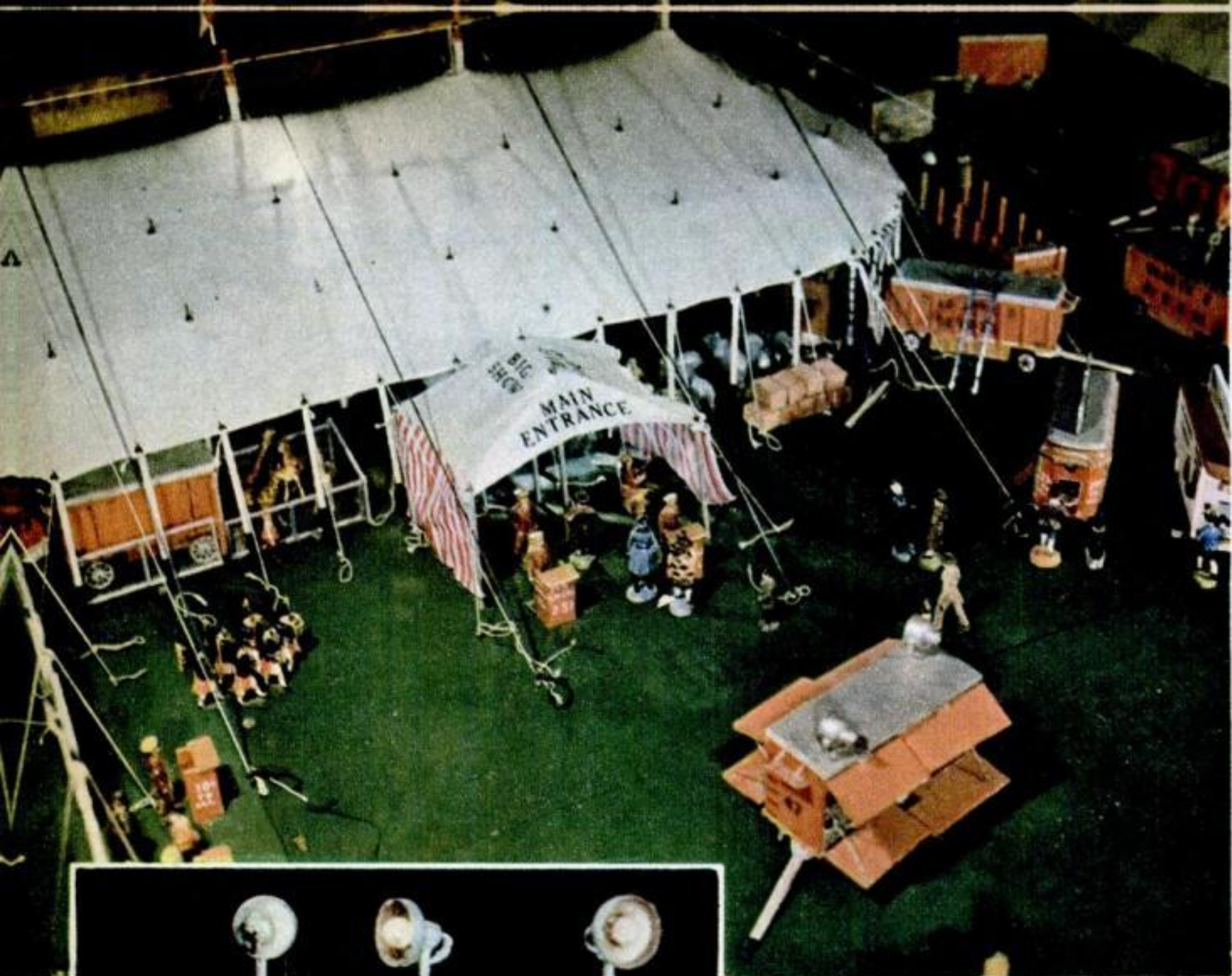
of circus folk. It's all pretty exciting.

Table-top circus modeling has already attracted 200 craftsmen, aged 16 to 75, from 28 states. All are members of the national association, which has its headquarters in Harrisburg, Pa. Organized in 1936, the association encourages intermember correspondence, sponsors exhibits, and issues membership cards that give the modelers access to the back-tent area of any show. Professional circus people welcome the modeler and give him valuable aid, while he in turn helps them slice through local red tape when the show visits his town.

Many modelers prefer to concentrate on animal and property wagons, which are more tricky to build than tents and side shows. Others have developed complete shows of their own, with impressive names such as "Wagner's Miniature Circus, Win-

This authentic model of a three-section den was copied from a wagon used by the Hagenbeck-Wallace Circus





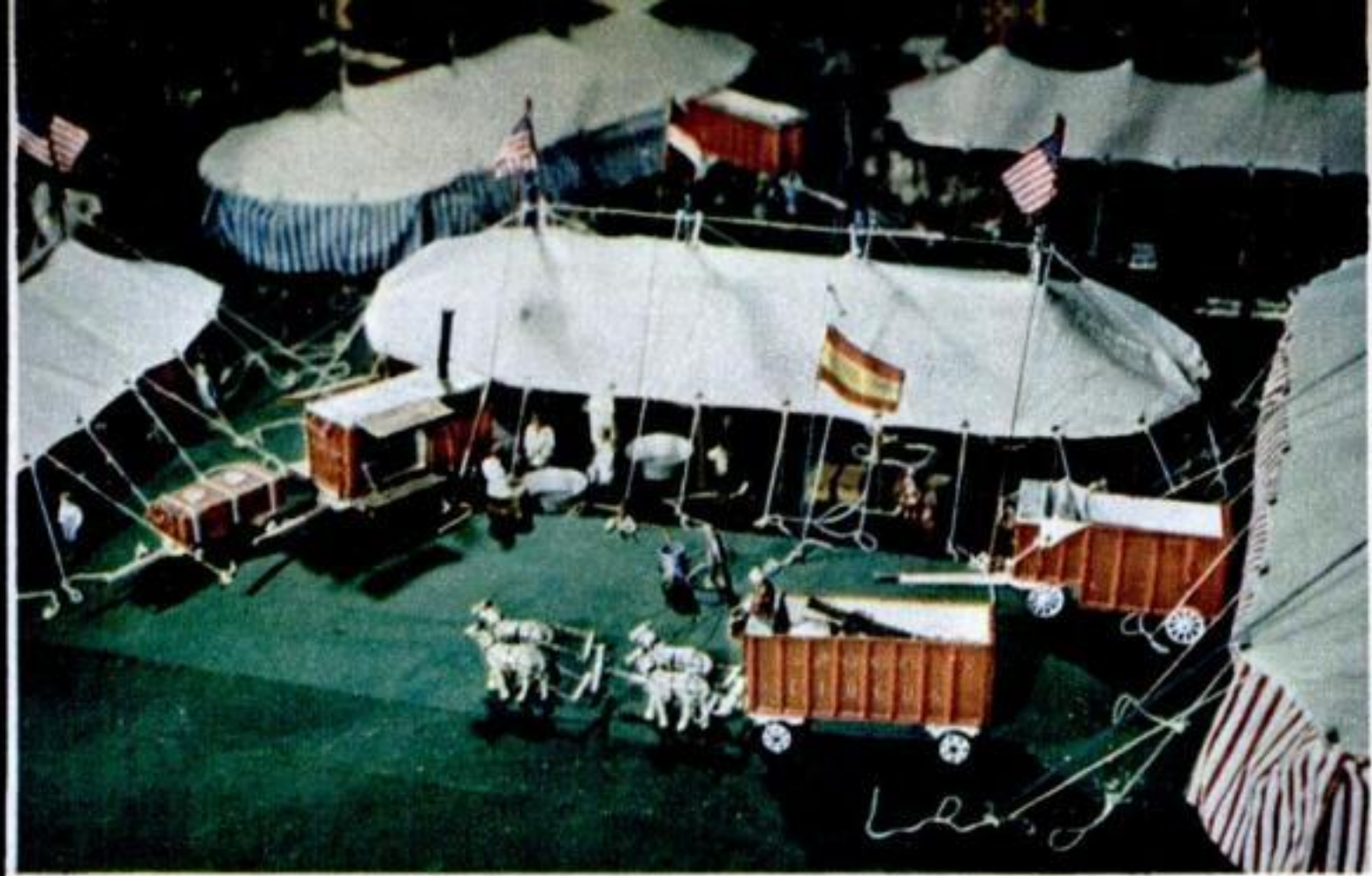
ter Quarters, Harrisburg, Pa.," "Hale Bros. Gigantic Shows," or "Updegrove's Greatest Hand-Carved Circus." Except for the power plant on this page, the illustrations here are all of the Wagner circus, owned by H. Russell Wagner, secretary-treasurer of the association.

Each modeler has his own favorite woods and methods of construc-

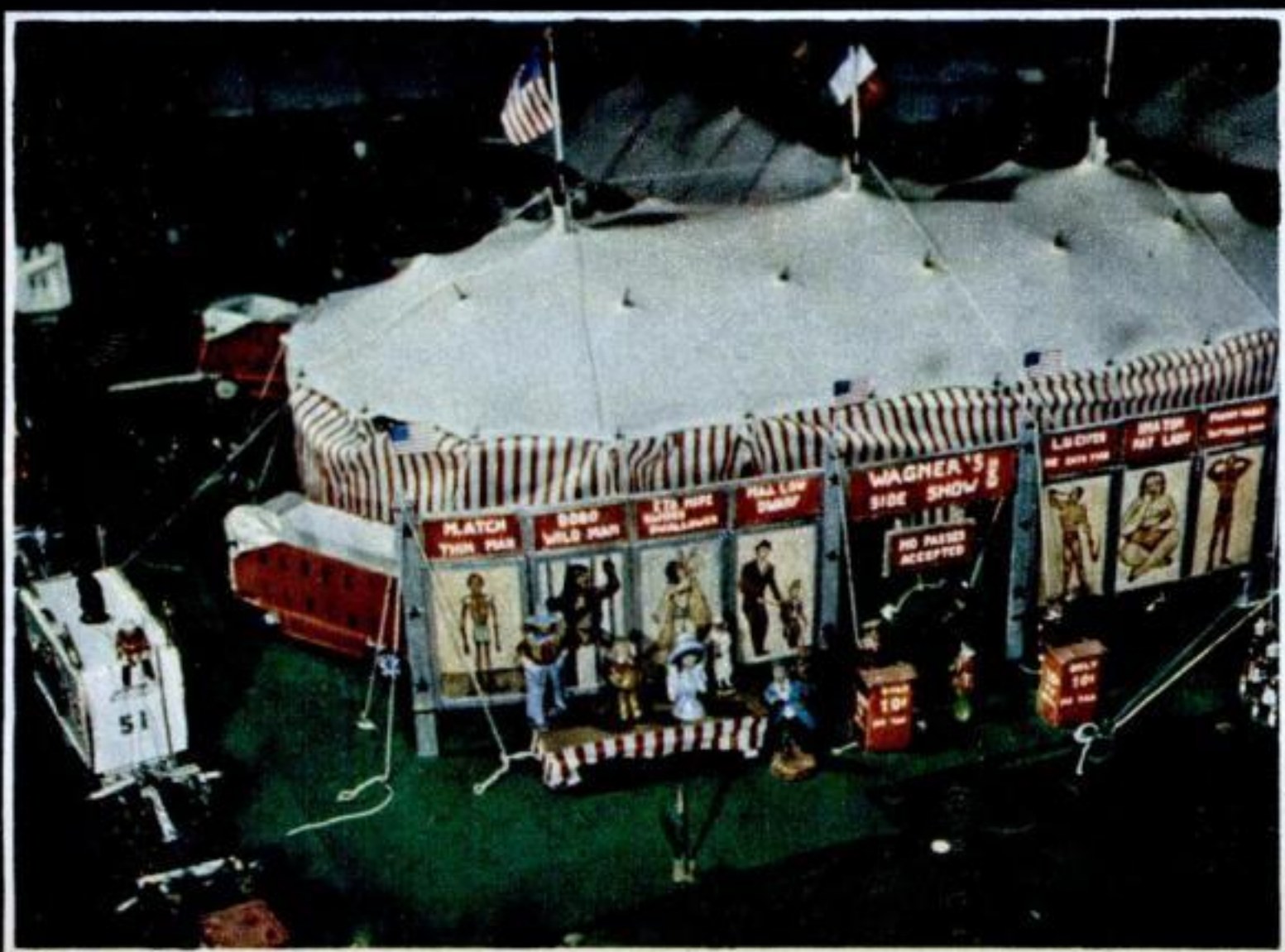
When the practical and mosaic parts of a circus are reproduced in models. This is the model power plant that generates electric current for the floodlights

made from a cheese box, this garish reproduction of a band wagon minutely reproduces everything but the blare harps and sour notes





The menagerie tent, shown above at center, is second only in importance to the big top. This model group also includes the mess tent in the back yard of the circus, where only employees and accredited modelers go



Two leaders of the Circus Model Builders and Owners Association, Charles Doelker (left) and H. Russell Wagner (right), giving the once-over to Wagner's table-top circus. The Association has 200 members

"Ladeez an' gen'l'men! Step right up and see this unparalleled and unprecedented aggregation of strange people from all over creation." This model side show is a triumph of make-believe

tion. Some like white pine for the wagons and others use brick-cheese boxes (yellow pine). Adornment of vans is a challenging problem. When brilliant paint isn't sufficient decoration, modelers often raid their wives' jewel boxes to unearth gay brooches, earrings, and other trinkets, which they glue onto their vans.

In spite of their love for gimcracks, the builders value realism above prettiness. A modeler hates an eye-catching wagon that shows flaky paint and rough edges. And band wagons, the public's favorites, are no more alluring to the good workman than the cooking and generator vans that do a show's dirty work.

Each wagon has its own team, four to six horses, depending on the load. While the modelers make the wagon bodies by hand, those unskilled in wood carving buy ready-made horses and paint on harness. The horses are then hitched to the doubletree that links them to the wagon proper. Reins are heavy buttonhole thread, which the driver "holds" through a hole drilled be-

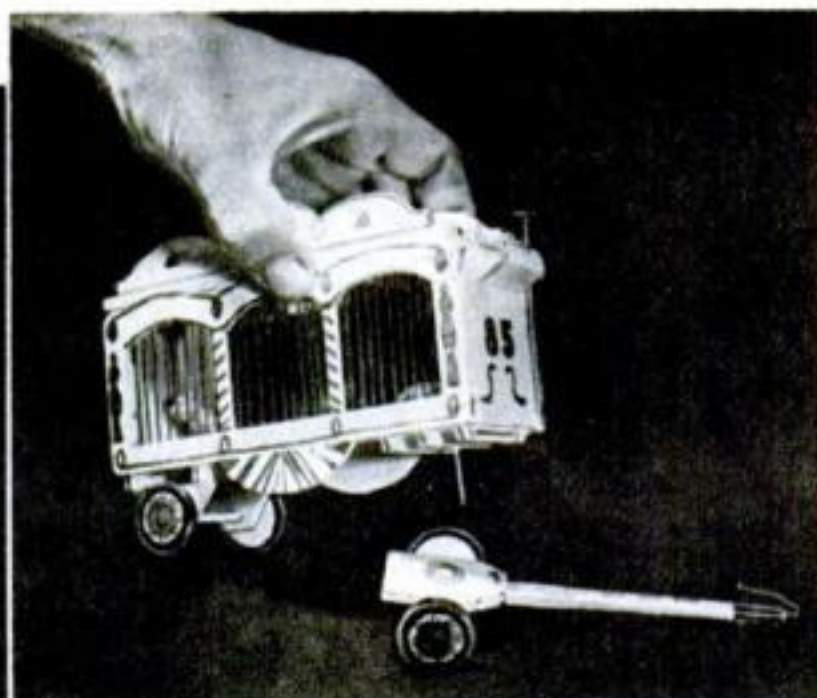
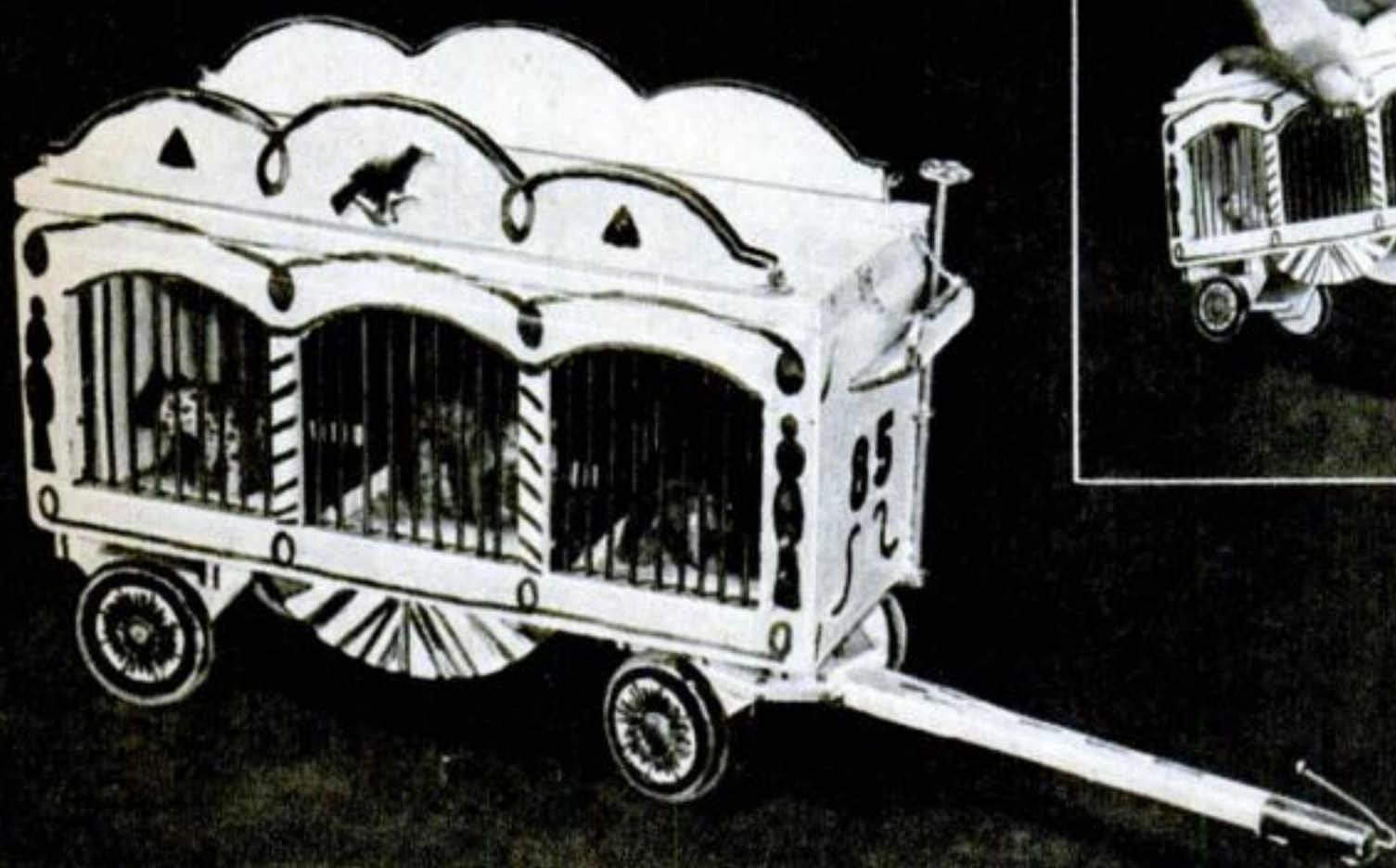
neath his arms. The effect is very realistic.

Wagner's three-ring setup is beautifully detailed. Arranged on a huge table in his basement workshop, the little big show, scaled $\frac{1}{8}$ " to the foot, is complete even to its own railroad rolling stock, into which the whole circus fits. A hobo lying beside the miniature tracks adds a touch of realism.

Circling the table is a parade of animal dens. First on the Midway, carefully placed for the sucker trade, is the side-show tent. Behind it are the menagerie and the big top. Back-yard tents, generally unnoticed by the public, are those for dressing, dining, blacksmithing, and truck shelter. These, along with the property, animal, and power wagons, and several bulldozers, fit into eight flatcars, four or more wagons to a car, while the horses travel in two stock cars and the elephants in their own bull cars. Performers have their own sleeper. In a real circus, the advertising car, stacked with posters and circulars, travels three days ahead of the show.

Some ingenious makeshifts Wagner has

MODEL DEN OR CAGE WAGON

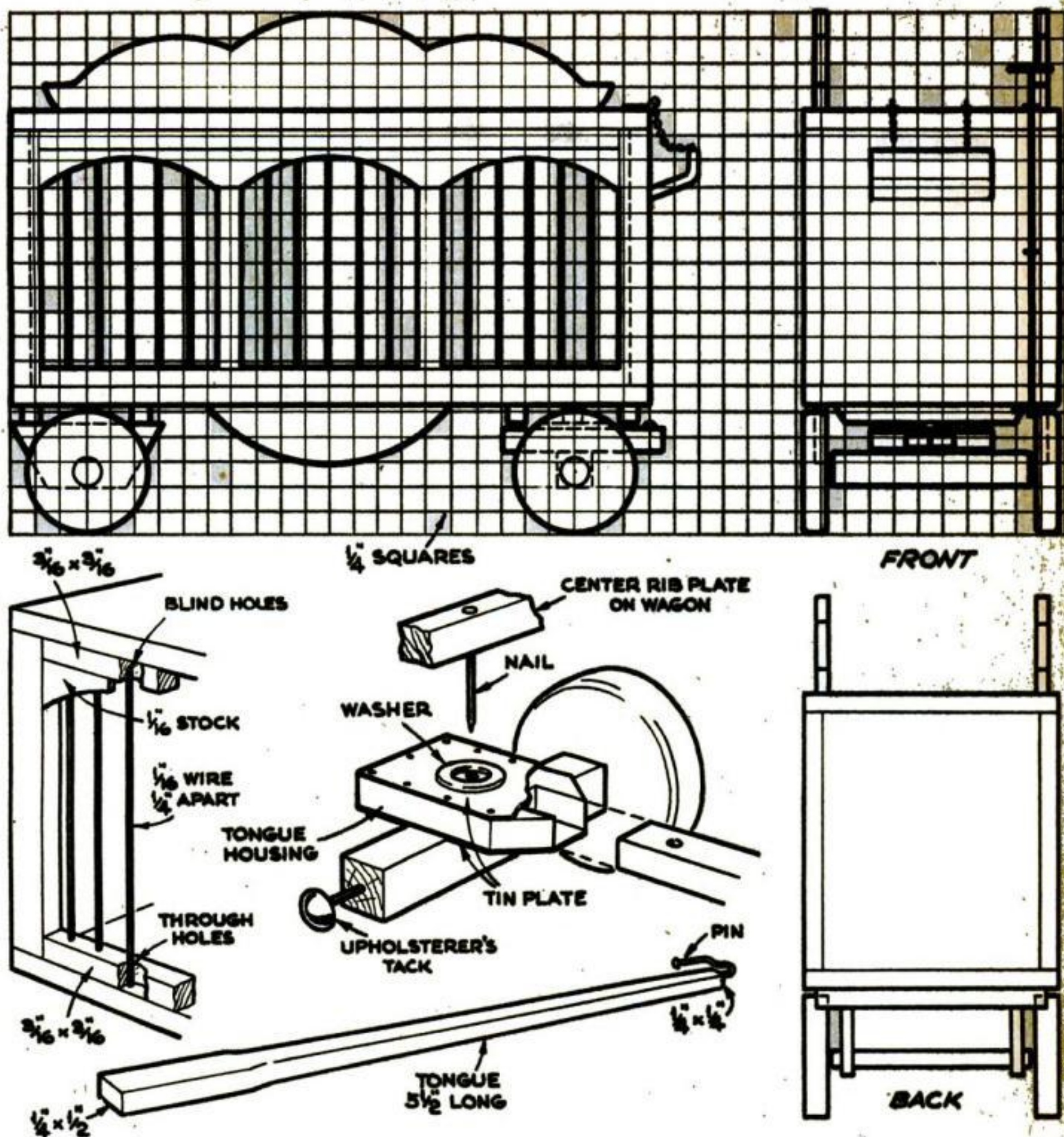


How the wagon body is attached to the front-wheel assembly. The hand gives an idea of the model's size

Decoration is mostly paint, but bottom flare is made by cutting ridges, sanding, and filing

Wheels are turned on a lathe faceplate from disks of $\frac{3}{4}$ -inch yellow poplar. Spokes are added separately





Side and end views, with details of construction for the den or cage wagon pictured on the opposite page dreamed up are a tiny load of hay made of dried grass rolled together in a miniature baler, and several sawdust "bales," which are blocks of wood covered with glue and rolled in loose sawdust. Horses' plumes are chopped-up bits of pipe cleaner painted in brilliant colors. Red, white, and blue standards that top the wagons are made from tricolor satin ribbon mounted on slender dowels.

Tent making takes more labor and patience than you'd think. A pattern must be designed from memory of a real circus tent, and the "canvas" (heavy muslin) measured, cut, and tightly sewn. Holes are punched along the circumference of the cloth and fitted with metal eyelets. Through each of these eyelets passes the straight pin that tops the corresponding tent pole and anchors cloth to pole. The pole is secured

In the side show, the legless girl once topped a perfume bottle, the pumpkin-headed boy was stripped from a Halloween decoration, and the giant was an outsized toy figure.

Tent making takes more labor and patience than you'd think. A pattern must be designed from memory of a real circus tent, and the "canvas" (heavy muslin) measured, cut, and tightly sewn. Holes are punched along the circumference of the cloth and fitted with metal eyelets. Through each of these eyelets passes the straight pin that tops the corresponding tent pole and anchors cloth to pole. The pole is secured by guy ropes—slender wrapping cord—which are tacked to the floor or table. The interior of the tents is carefully detailed, although this workmanship is rarely appreciated by a casual visitor.



"Rainbow" coated with molybdenum, this copper plate shows only one of the unlimited number of brilliant color patterns that can be produced by moving the positive anode over the plate



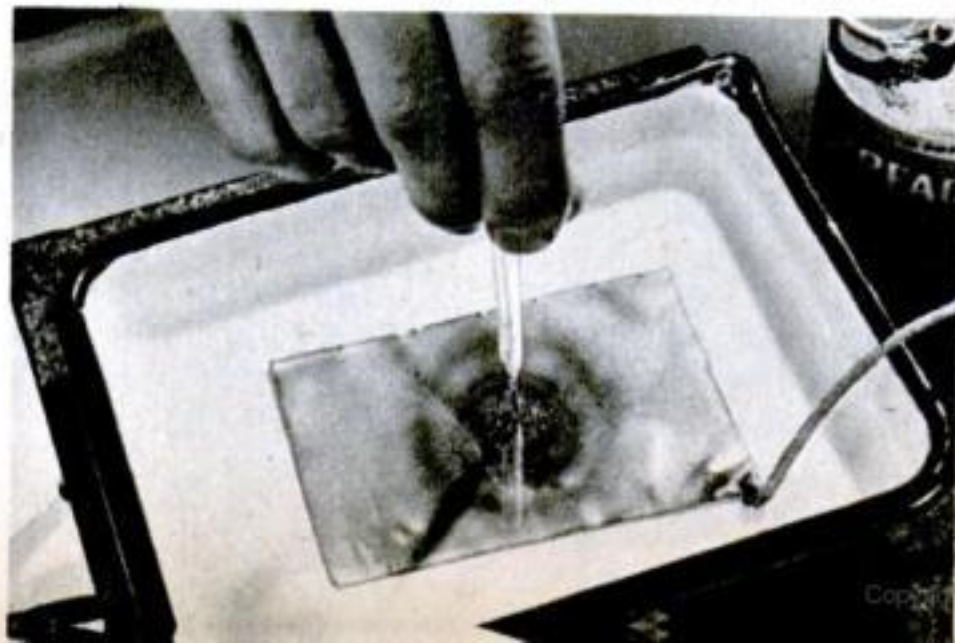
Electroplating Puts Colors on Metal

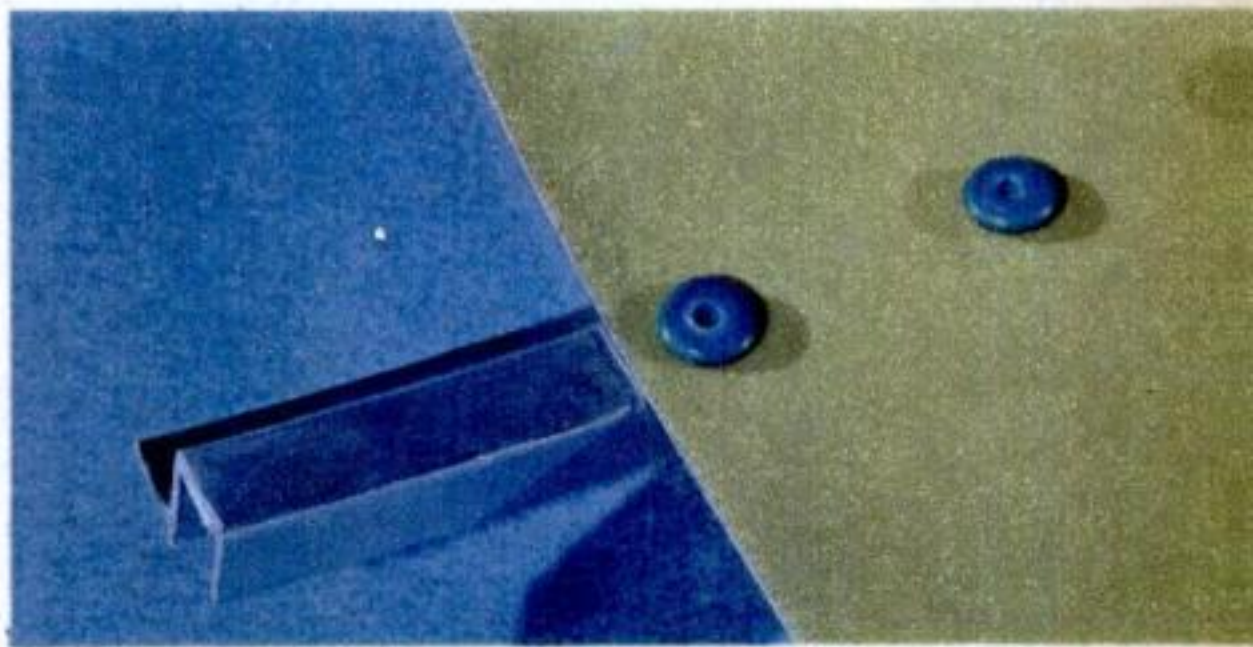
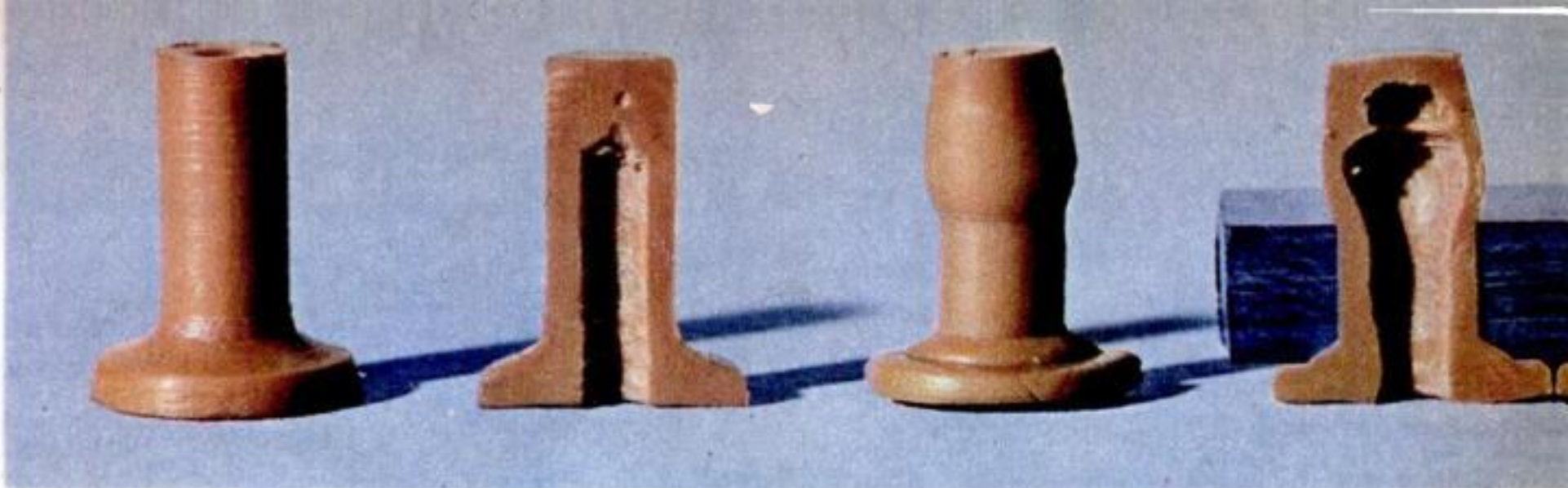
RAINBOW" plating—a seemingly magical electrolytic process of applying multicolored designs to metal without the use of pigments—has been developed by the well-known electrochemist Oliver P. Watts. Secret of the process lies in light-wave interference between the surfaces of a semitransparent plating of molybdenum. As in a soap bubble, brilliant colors are produced by light reflection from surfaces only half a wave length apart. By minutely varying the plating's thickness, hues of the entire spectral range can be produced.

1 Plating bath is hot solution of ammonium molybdate. Negative pole of four-cell battery is attached to metal plate; positive pole to the anode

2 The plate is laid on the bottom of the tray, and the anode—a platinum wire projecting slightly from a glass tube—is dipped into the bath above it

3 Color rings form as soon as anode is inserted and gradually expand, reaching plate's edge in about 30 seconds. Overplating makes colors vanish





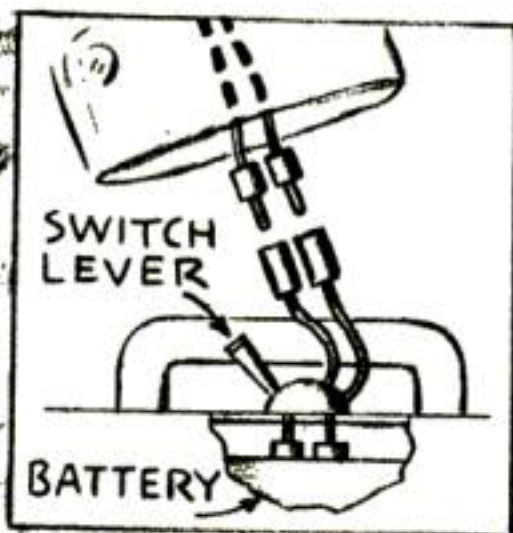
PLASTIC RIVETS have been developed by S. H. Phillips, process engineer of the Douglas Aircraft Company's El Segundo, Calif., plant, for attaching fabric to metal, wood, or plastic, and metal to plastic sheeting. Tests have proved their strength and ver-

satility; and, owing to the colors obtainable, the rivets promise wide adaptability to peacetime uses. Even greater than normal tensile and flexural strength is obtained by electroplating the plain rivets. The photos show the rivets and their application.

THIS GLASS WAS TOUGH. So was the gunner of the Ninth Air Force in the tail turret of the B-24 Liberator bomber. When a 20-mm. shell from a Nazi Messerschmitt struck the window, the gunner, whose view was obstructed by the damaged glass, continued to fire at the enemy and was officially credited with a kill.

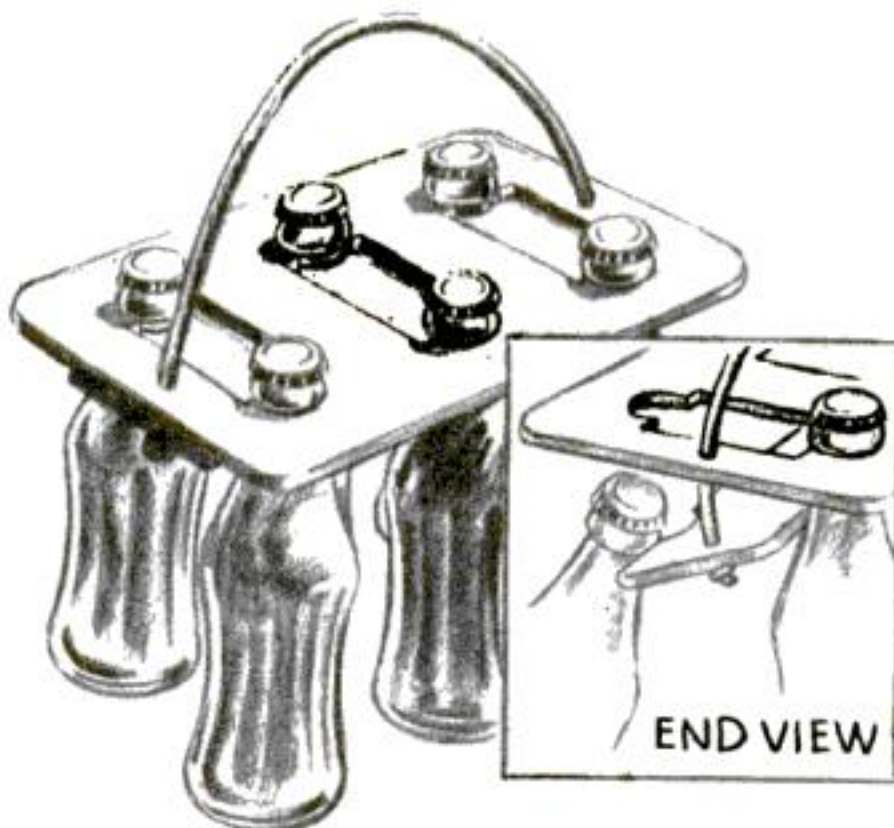


"GO FOR BROKE" is the motto of the loyal Japanese-Americans who compose the 442nd Combat Team of the U. S. Army. The expression is the equivalent of "Shoot the works." The Liberty torch shoulder patch shown above is the unit's insignia.



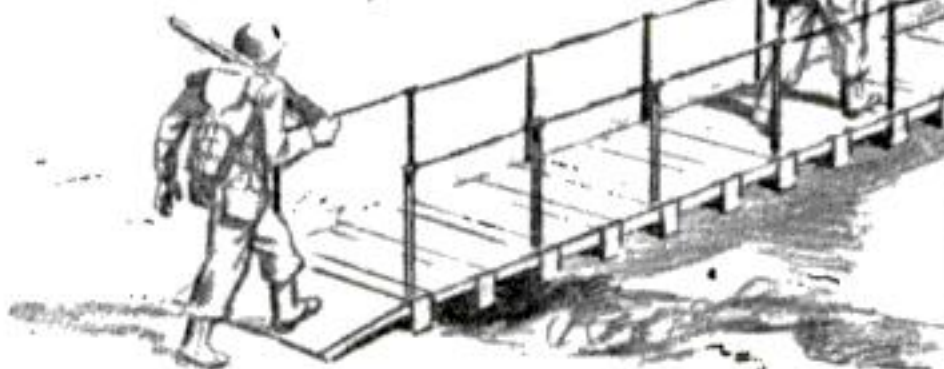
NO NEED TO BE COLD this winter if you take advantage of the idea of William W. McCready, Boston inventor, who has devised an electrically heated overcoat with an accompanying portable source of battery current. As in similar blankets and aviators' garments, heating wires are distributed through the coat. Two flexible leads are carried down the sleeve and are plugged into the battery carrying case. There is a conveniently located switch near the handle for regulating the heat, but when the battery is set down, the connection is broken.

CARRYING POP HOME will be simplified by a new device invented by Keith W. and Clyde B. Burge of Gary, Ind. A slotted rectangular sheet of compressed paper board, plastic, or plywood fits over the tops of six beverage bottles, and an underpiece of the same material, secured by a stout carrying cord, is drawn upward to lock under the bottle heads. A snug fit prevents bottles from breaking by coming in contact with each other.

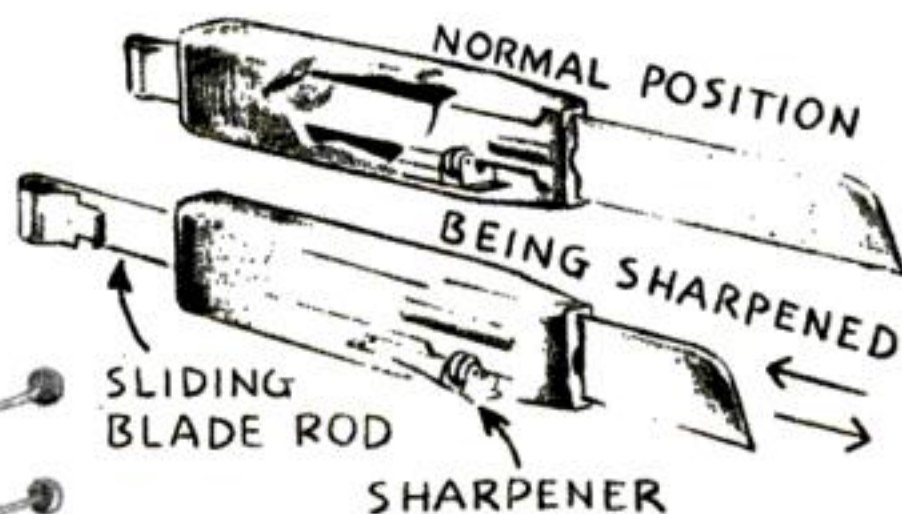
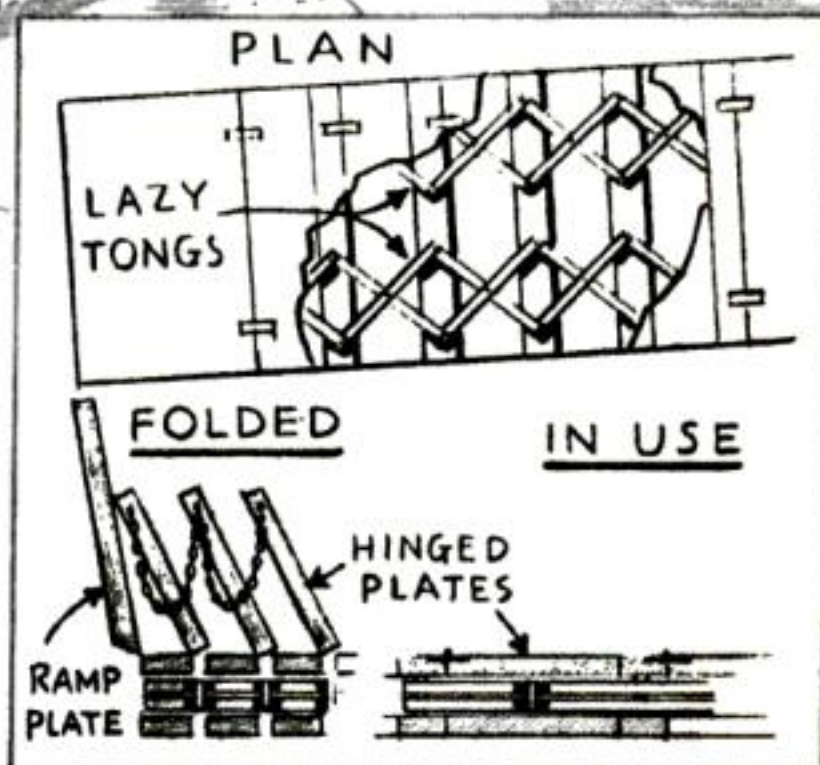


A BETTER WORLD is promised by David E. Sites, of Chicago, in the form of a self-righting map globe for home or classroom use. Inside the globe is a circular channel in which a weight slides, so that when the globe is placed on a desk or table its polar axis automatically assumes the correct inclination of $23\frac{1}{2}$ degrees from the vertical, corresponding to the tilt of the earth's axis with reference to the plane of its orbit. In this way, the globe dispenses with the usual clumsy stand. It can be moved and handled easily for study of any part of the map, or used to explain the changes of the seasons.

the inventors

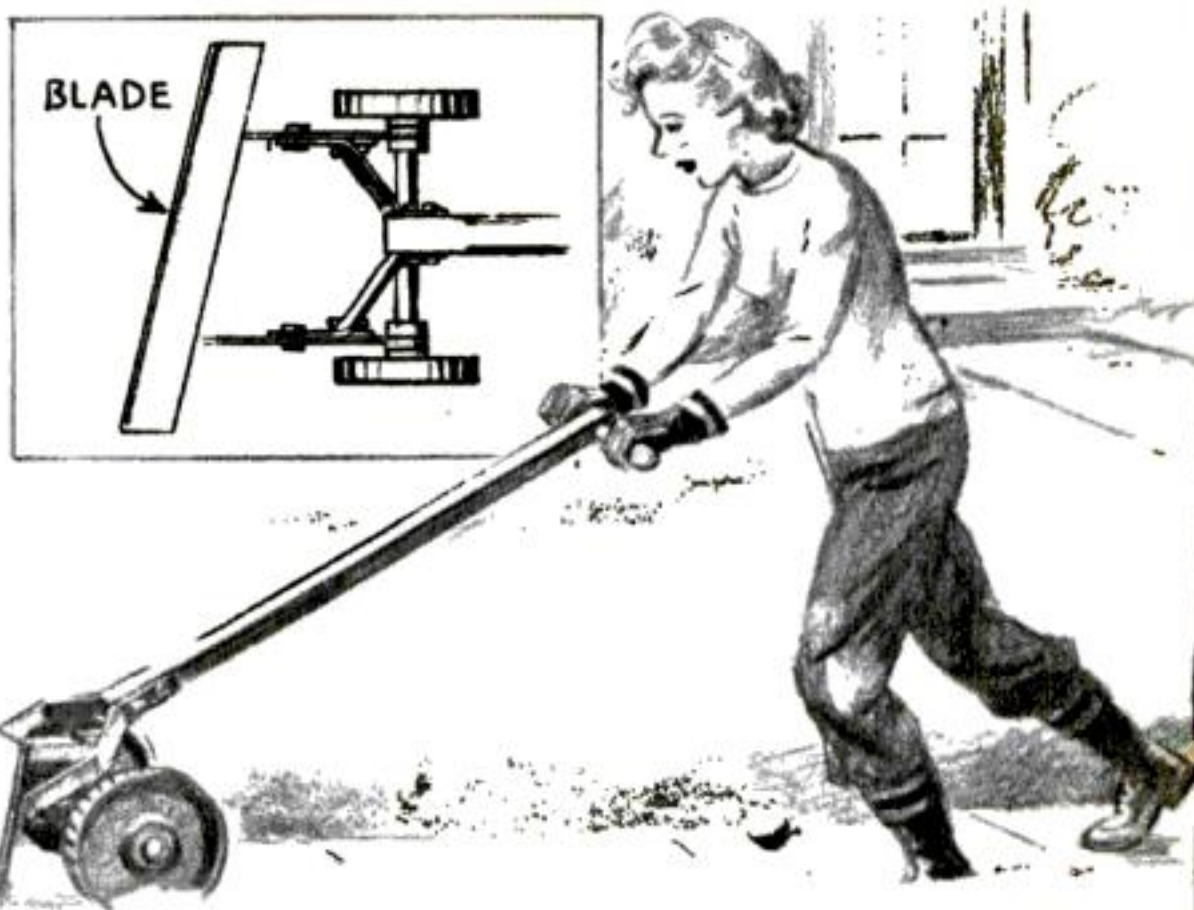


A FOLDING BRIDGE devised by Alfredo Heldenreich, Buenos Aires, Argentina, is intended to provide a portable foot crossing for narrow streams and other obstacles. Transverse beams are joined by a lazy-tongs arrangement that allows the bridge to be stretched across the gap to be spanned. Hinged plates fall into place between the beams to form the floor, and chains along the sides help support the weight. If desired, the bridge can be laid over pontoons as shown above.



THIS KNIFE HAS THE EDGE on most other cutlery because it carries a built-in sharpener. Its hollow handle conceals a set of sharpening rolls similar to those found in nearly all well-regulated kitchens. When the knife gets dull, the user gives the metal extension at the base of the blade a pull-push motion, which carries the cutting edge back and forth across the sharpener. An easily workable locking device secures the blade in cutting position. Earl L. Frank, of Minneapolis, Minn., is the man who developed the idea.

HAND SNOWPLOW. Removing snow from sidewalks and driveways should be easy with a pusher invented by Joseph Leunis, of Scarborough-on-Hudson, N. Y. Somewhat resembling a lawn mower, the two-wheeled tool is fitted with a pusher blade and an adjustable handle that regulates the height of the blade above the ground. As a hand-powered bulldozer, the pusher can also be used for moving dirt, rubbish, and other material about the yard.





Although "enamel" has come to mean everything from dime-store paint to nail polish, actually it is finely ground glass that is strongly or weakly colored, and then applied wet to a base where it is baked to a hard, glossy finish. An assistant (left) to Harold Tishler, one of the few hand enamellers practicing the craft in this country, is shown applying a layer of colored glass to the little donkey that appears above. Each layer of glass requires an individual firing, at temperatures ranging from 1,200 to 1,500 degrees. The donkey required seven separate firings in a kiln

HAND-FIRED GLASS ENAMELS

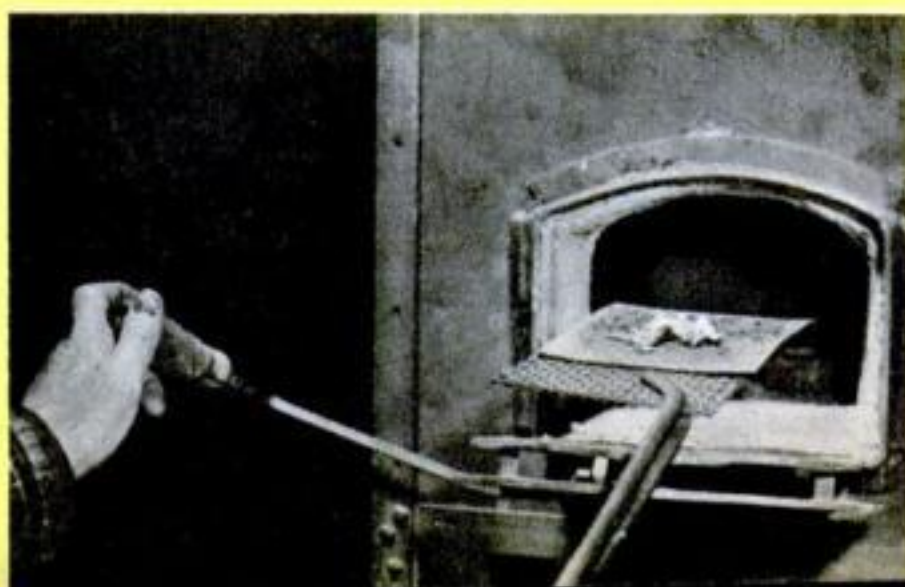
How costume jewelry, bowls, plates, and other ornaments are embellished with lustrous colors applied with a brush in layers and baked in a kiln.

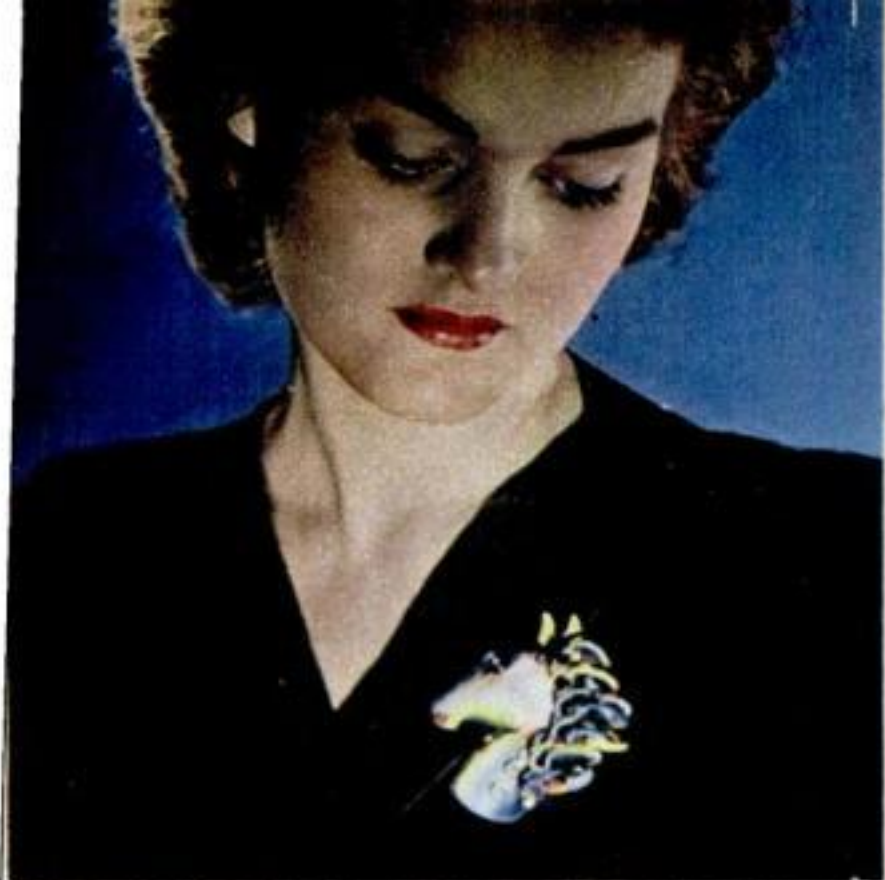
IN HIS small New York skylight studio, Russian-born Harold Tishler, a former landscape painter who has also studied ceramics, has found a lively career for himself in the almost extinct art of hand enameling—the painstaking handicraft of painting and baking finely ground glass, white or colored, on metal, glass, or pottery. Working with a tiny kiln that he has to keep fired 14 hours a day to meet the

SHAPING THE BASE AND FIRING ITS LAYERS OF GLASS

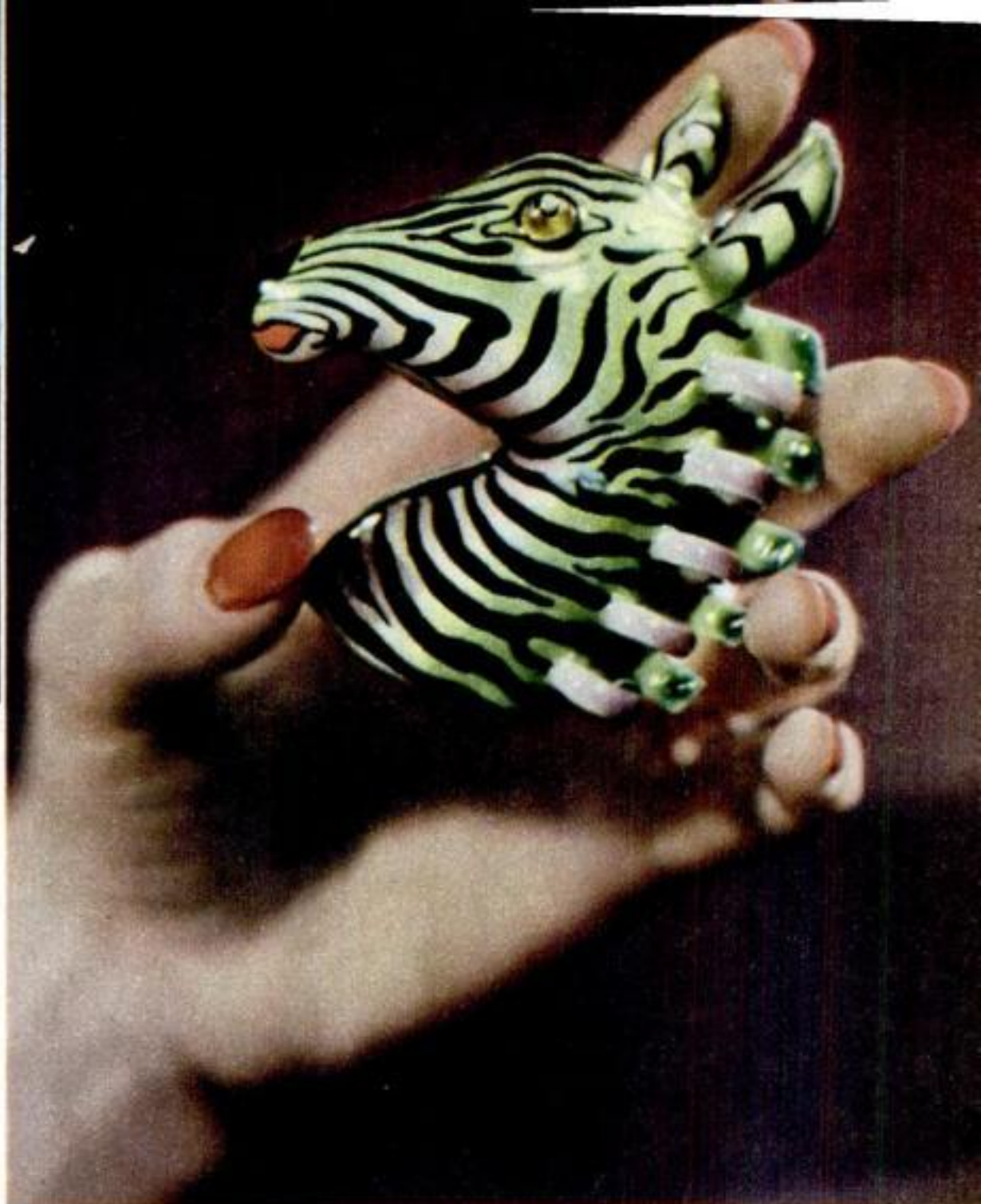
His metal bases properly cut, Tishler hammers them to shape on wood forms and then adds the "master's touch" by finishing the modeling with his fingers

A sulphuric acid bath, a coating of gum—and a base is ready for its glass layers and many trips in and out of the kiln. At right, Tishler examines work





This zebra head (above and at right) is another of the costume pieces designed and produced by Tishler. The glaze is resistant to cracking and chipping, and should last a lifetime with careful handling. As a base for his enamels, Tishler uses either copper or silver, the latter producing beautiful tints of blue, purple, and sea green when covered with translucent enamels. Although most colors are unchanged by the firing, a pink glaze is obtained from a white powder, and a purple glaze from a light blue

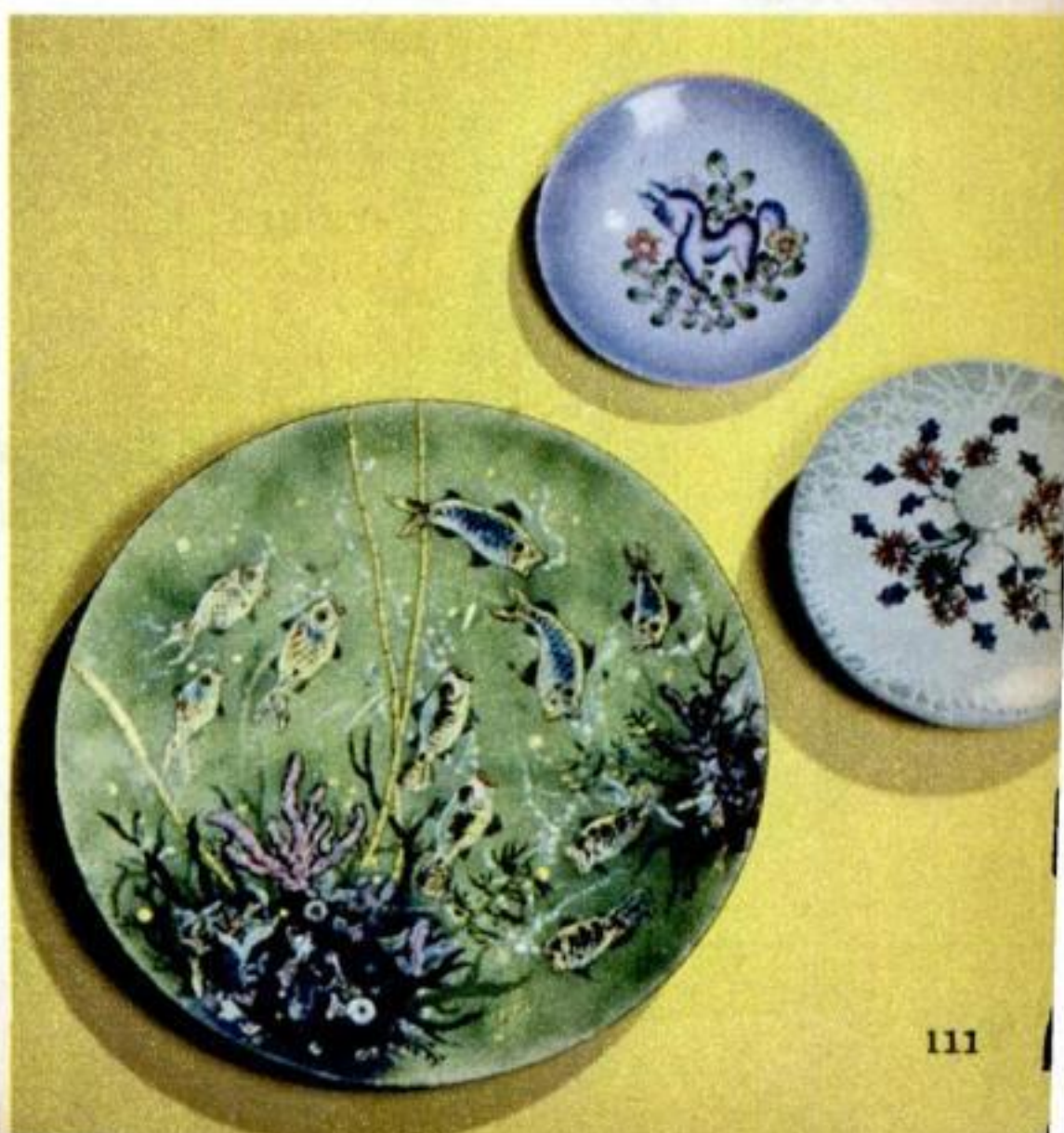


Photographs by William W. Morris and Robert F. Smith.

DECORATE UNIQUE CRAFTWORK

demand, Tishler turns out exquisitely colored bowls, plates, and trays as well as pieces of costume jewelry that retail at 20 and 30 dollars. After the war, Tishler plans to produce decorative tiles for fireplaces as well as scenic plaques that can be set in living-room walls as murals.

These plates, too precious to be eaten from, are intended as decorations to be hung on the wall or placed over the mantelpiece. The iridescent hues are the result of a silver base and translucent enamel.



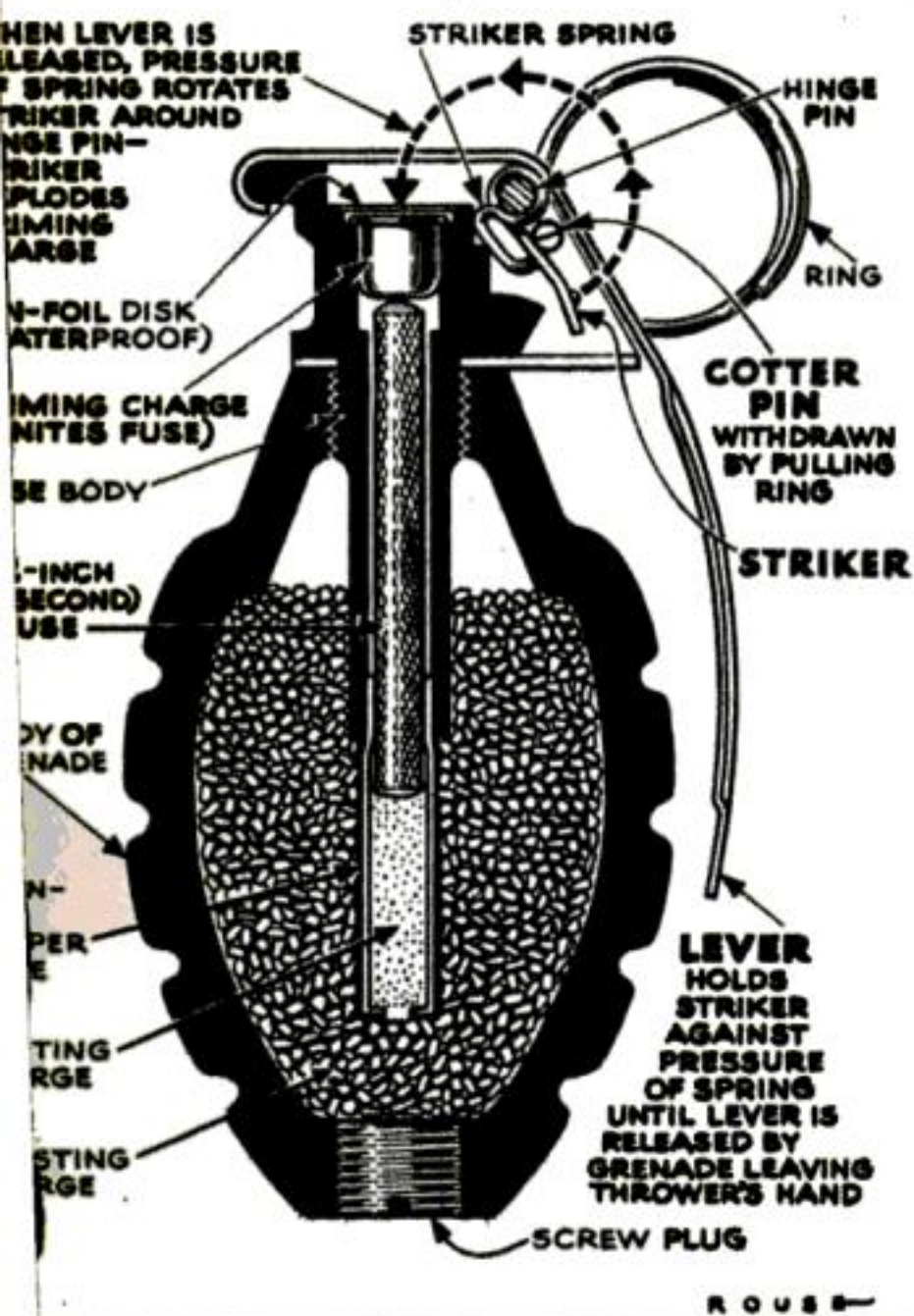
"Get Good with the



Possibly the oldest firepower weapon, it is still a decisive factor in hand-to-hand combat. Here's the colorful story of its development and its role in war from the Middle Ages up to now.

By ARTHUR GRAHAME

THE MECHANISM OF A HAND GRENADE



THE best thing that can be said about our fragmentation hand grenade is that the Japs are scared to death of it.

An ingenious and deadly contraption of cast metal and explosive, it looks like a somewhat oversize green lemon, costs 54 cents, and is simple to manufacture. It weighs 1½ pounds. The average soldier can lob it 30 to 35 yards. A really good grenade thrower can drop it neatly into the lap of a Nip 150 feet away. Five seconds after it leaves the thrower's hand, it explodes and blasts 40-odd jagged fragments of its metal body over a 30-yard radius at 3,000-feet-per-second velocity.

The machine-made hand grenade of today is the direct descendant of what was perhaps the first firepower weapon. The Saracens probably used earthenware grenades when they besieged Salonika a thousand years ago; history records that bottles filled with gunpowder were used in the

FOUR OF THE PRINCIPAL



FRAGMENTATION



SMOKE

Grenade . . . It Pays!"

siege of Casalmaggiore, in Italy, a half century before Columbus set sail for America. At any rate, the grenade had become an important tool of warfare by the beginning of the seventeenth century. Even then, munitions makers must have known something about quantity production, for when the Spaniards attacked Ostend in 1602 they threw 50,000 grenades at the defenders and the embattled Dutchmen hurled 20,000 back at them.

By about 1650 the hand grenade had become more or less standardized in the form of a hollow bronze, brass, or cast-iron ball from eight to 14 inches in diameter, weighing from three to six pounds, loaded with black powder, and exploded by a fuse lighted just before the missile was thrown.

Men who were husky as well as brave were needed for the job of grenade throwing, and in most European armies the tallest, strongest, and toughest soldiers of each infantry regiment were organized into special grenade units. For over a century these grenadier companies played a conspicuous part in warfare, which then consisted mostly of attacking and defending fortifications. But eventually the improvement in small arms and the adoption of more fluid fighting tactics combined to rob the grenade of much of its effectiveness. Rifle grenades date back to 1743, but they never were widely used in the days of the muzzle-loading musket.

In our Civil War both Federals and Confederates occasionally used grenades in the defense of fortifications.

One type was the rampart grenade, a thin-walled, cast-iron shell loaded with black powder and exploded by a fuse which was lighted just before the grenade was rolled down the slope of the rampart on the attackers. In Tunisia, 80 years later, the Germans used grenades against us in a similar way. Manning the crests of the steep, bare ridges, they rolled hand grenades down on our advancing infantry.

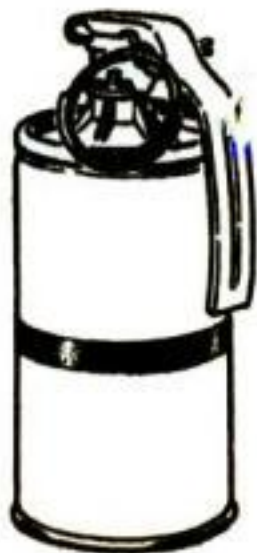
About 1870 our Army adopted Ketchum's grenade. This was a small, oblong cast-iron shell loaded with black powder, and it had two distinctive and revolutionary features—

A NEW GRENADE LAUNCHER

Designed for use on the Garand rifle, the launcher, which can handle antitank, hand-fragmentation, and 30 different types of signal grenades, is inspected by its designers, Colonel Charles H. Coates and Ray S. Miller, foreman of the post ordnance shops at Fort Benning, Ga. Prior to the new launcher, grenades could be fired only from Springfield rifles



TYPES NOW BEING USED

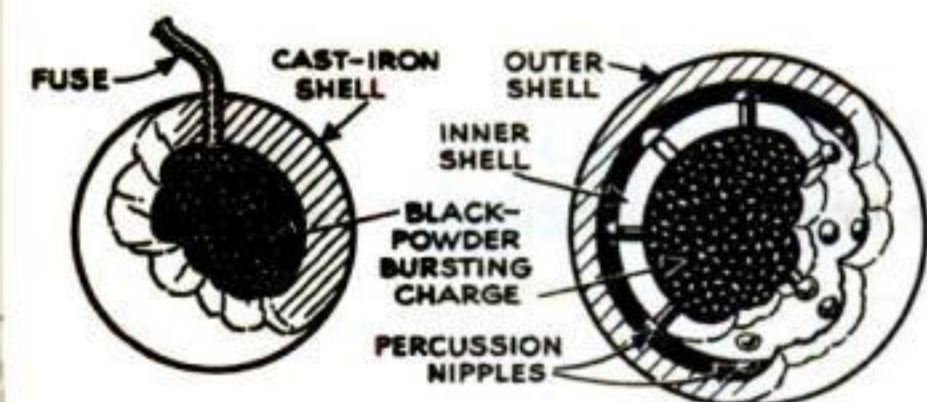


A PICTORIAL REVIEW OF THE ROLE THE HAND GRENADE

Manuscripts of the early 14th century show the grenade being used in the defense of besieged cities and castles. In 1602, at the siege of Ostend, over 70,000 grenades were hurled. They were also used by Louis XIV, by the Prussians at the Battle of Malplaquet in 1709, in the siege of Sevastopol, and in the Russo-Japanese war. Not until World War I, however, were grenades of modern type introduced

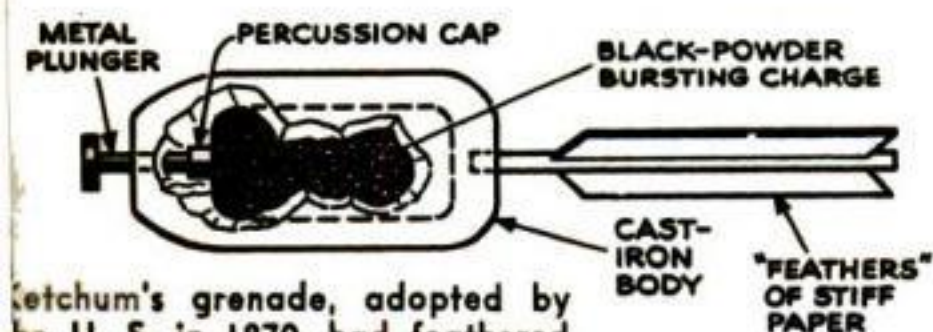


THE EVOLUTION OF THE GRENADE SINCE 1650

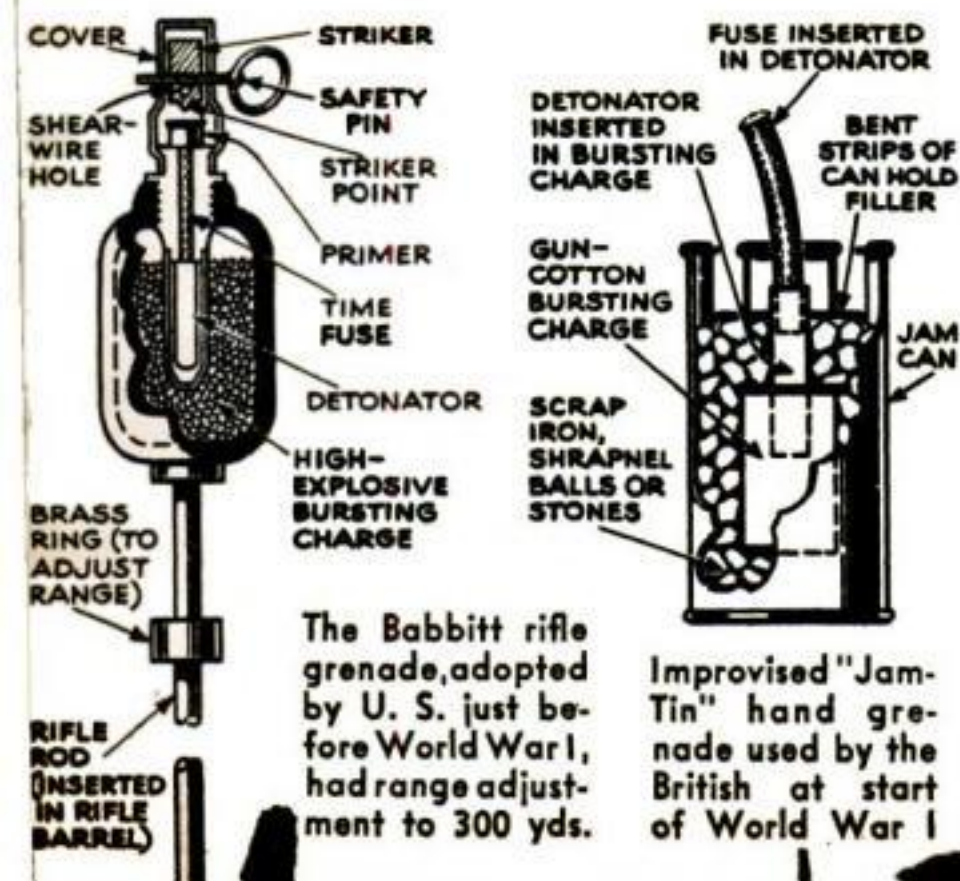


Grenade of 1650 was 3 to 14 inches in diameter, weighed three to six pounds. Fuse was hand lit

U. S. Civil War type detonated when the impact forced percussion caps against the outer shell



Ketchum's grenade, adopted by the U. S. in 1870, had feathered tail rod to insure its head-on flight



The Babbitt rifle grenade, adopted by U. S. just before World War I, had range adjustment to 300 yds.

Improved "Jam-Tin" hand grenade used by the British at start of World War I

a tail rod "feathered" like an arrow's shaft with stiff paper to insure its head-on flight, and a metal plunger, inserted in the grenade's nose just before it was thrown, which on contact with even a slightly resisting object detonated a percussion cap that fired the bursting charge.

Ketchum's was a big improvement over any previous grenade, but it soon was forgotten. Military men of all nations were sure that there never was going to be any more close-quarters fighting, that "modern" firearms had made it impossible.

They had to change their minds about that when the Japanese besieged the Russians in Port Arthur in 1904. The battle soon became a trench-warfare deadlock with the trenches separated, in many places, by a no man's land only a few yards wide. Under these conditions neither artillery nor rifle fire was effective, and both sides improvised hand grenades—the first high-explosive grenades. The Russians used old spherical shells and sections of brass artillery cartridge cases loaded with dynamite, and soon were producing a thousand grenades a day. The Japs used bamboo joints loaded with a pound of cast picric acid and filled with scrap iron. When ammunition ran short on Bataan in 1942, our men improvised very similar bamboo grenades.

Interest in grenade warfare induced by its effectiveness at Port Arthur was short-lived—the brass hats decided that the conditions of that struggle wouldn't occur again. But the extensive use of hand grenades by the Turks and Bulgarians in the Balkan War of 1912 had more effect. The British adopted, and produced in very limited quantity, a high-explosive grenade that made use of two of the features of our old Ketchum's grenade—tail streamers to insure its head-on flight, and a metal plunger to fire a detonator which exploded the bursting charge. The Germans adopted



1696



1709



1917

several types of hand grenades and began manufacturing them in quantity.

At that time our Army wasn't interested in hand grenades because our tacticians figured that the way to win a battle was to outshoot the other fellow at gradually decreasing ranges and finally run him off the field with a bayonet charge. But it *was* interested in increasing the firepower of the infantry, and for that purpose our first rifle grenade, the Babbitt, was adopted. Fired from the Springfield rifle, it consisted of a high-explosive-filled metal head and a steel tail rod grooved for ranges up to 300 yards. The range was determined by slipping into the proper groove a brass ring that fitted over the rifle's muzzle and was acted upon by the expanding gases gen-

erated by the burning of the powder of a blank cartridge. The greater the length of rod inserted in the barrel, the greater the gas pressure and the longer the range. A metal striker in the nose of the grenade was held away from the primer by a safety pin and, after the pin was withdrawn before firing, by a thin wire. When the trigger was pulled, the shock of the propellant starting the rod out of the barrel threw the point of the striker against the wire, which it cut. The striker then hit the primer, which ignited a fuse. After burning for eight seconds, the fuse set off a detonator that exploded the bursting charge.

Before the outbreak of World War I, both the British and the German armies

RIFLE GRENADES OF FIRST AND SECOND WORLD WARS



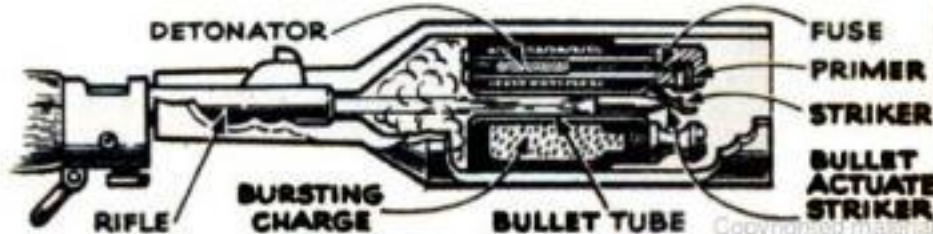
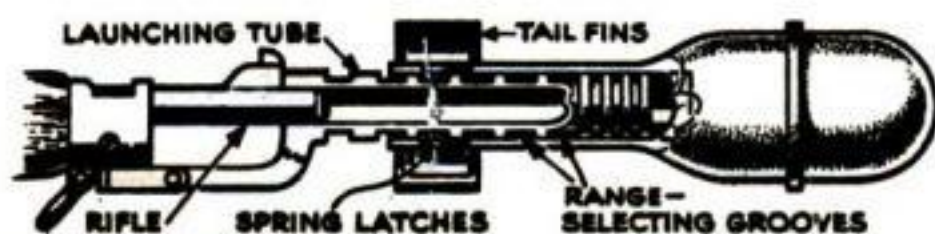
A doughboy of 1918 prepares to launch a Babbitt (shown on the opposite page)

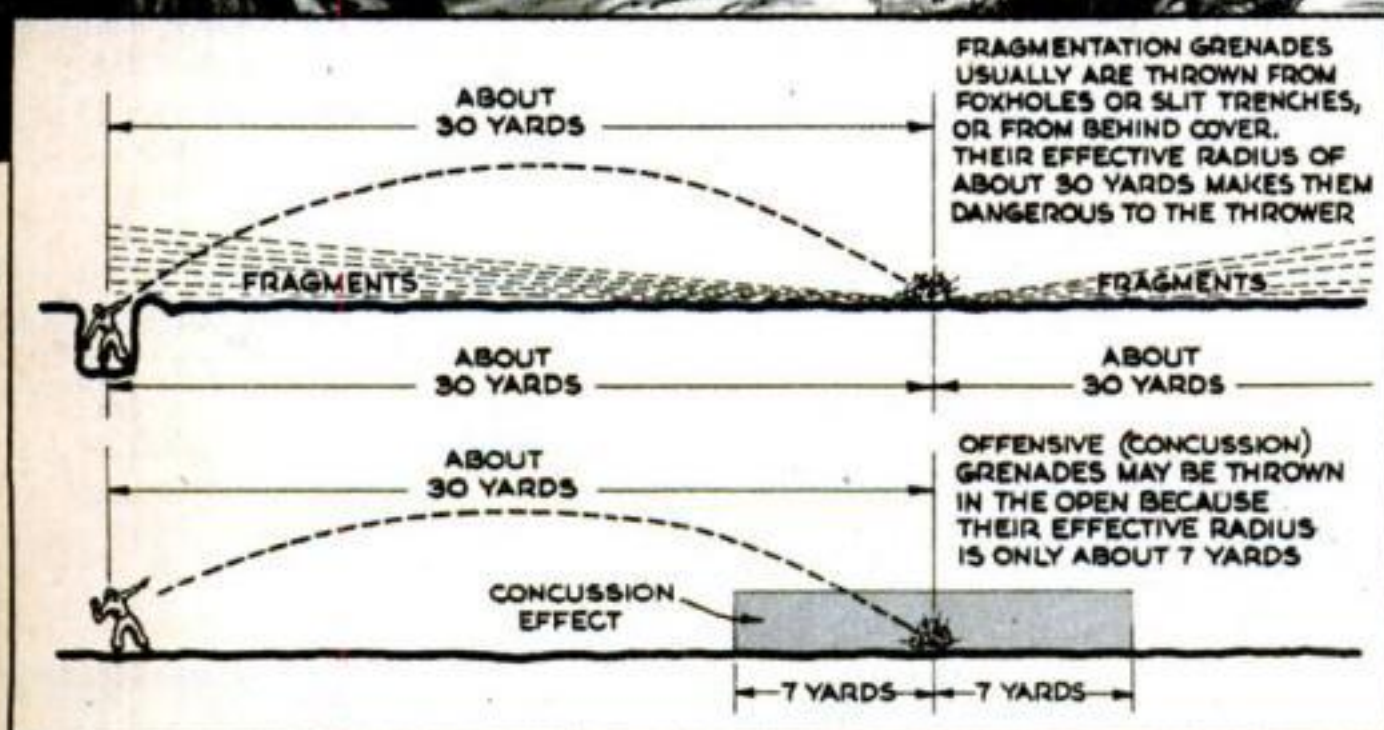
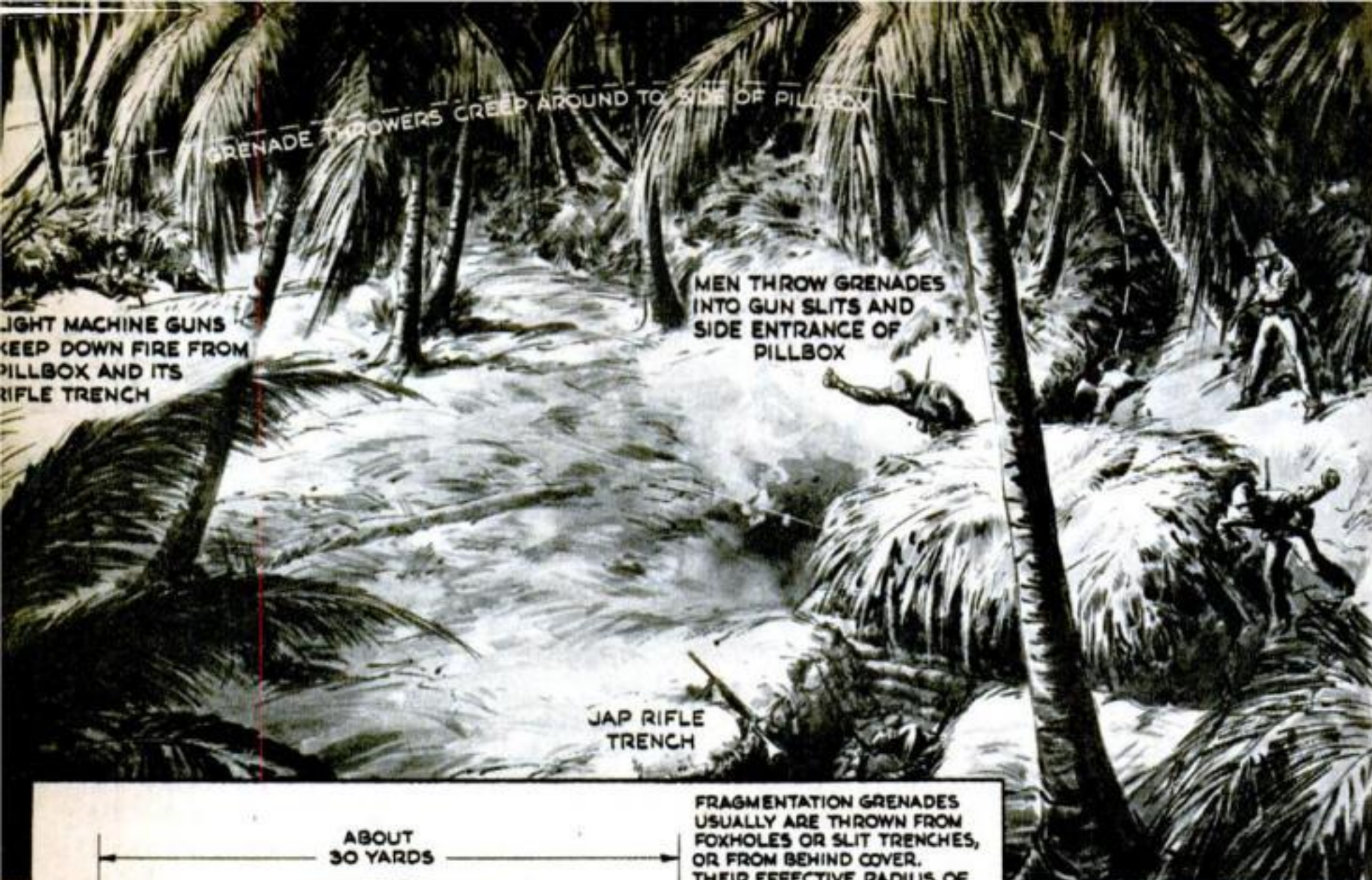


Current antitank grenade developed by Army ordnance. Diagram below, left



The "V. B." of World War I, which, in improved form, we still use for jungle fighting. Mechanical details are below





Drawing by B. G. Seielstad
Most men can't throw a grenade much farther than 40 or 50 yards. Fragmentation grenades with an effective radius of 30 yards are therefore completely safe only when thrower has protection. For jungle warfare, where protection is not always available and fighting is at close quarters, U. S. soldiers use a short-radius concussion grenade

adopted rifle grenades of the rod type.

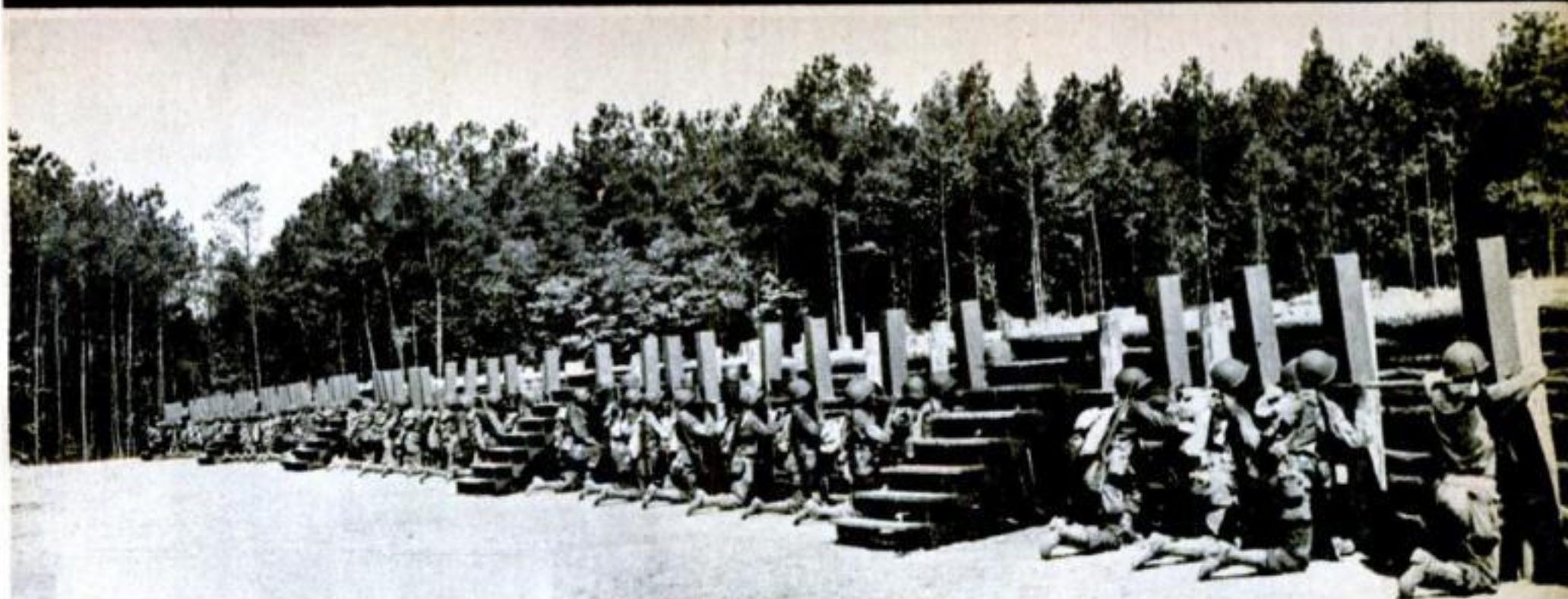
Trench warfare started as soon as the Germans were stopped at the Marne in the early fall of 1914. Possession of an adequate supply of effective hand grenades gave the invaders a valuable initial advantage in the grim war of ditches. The Allies at once designed grenades, but during the six months it took their factories to get into production the British and French soldiers had to fight back with improvised bombs—usually tin cans in which pieces of scrap metal, or even stones, were

packed around a charge of dynamite or guncotton.

The hand grenade continued to be an important weapon throughout the war, and many types were developed. The Germans' favorites were two models which they still use: the "potato masher," a stick grenade with a six-second fuse fired by a friction lighter, with igniter and wire pull inside the handle; and an egg-shaped percussion grenade weighing only 11 ounces, which the average German soldier can throw 50 yards. (Baseball men say that, from the

A War College sergeant shows some of the finer points of grenade pitching. First (left to right) how grenade is held; second, the proper stance—with left arm raised, right arm cocked, body slightly back on right foot. Pulling the cotter pin while prone (third) he shows how a man can quickly get to his knees to let one fly





Using periscopes from behind an embankment, trainees (above and left) at Camp Lee, Va., get close-up view of bursting grenades



Using a "live" grenade from which the pin has been pulled, an instructor (at right) demonstrates the proper grip. Thumb and forefinger are kept well back from firing mechanism to avoid danger of their becoming entangled. Note how the arm is cocked back in position similar to that used by a baseball catcher making a fast "peg." Original stiff-arm method was found unsuitable to the baseball-trained arm of the average American GI



An instructor carefully coaches a rookie "pitcher" about to let one go from behind a heavily sandbagged training bay (lower left). With the grenade away, they duck for cover. Trainee makes a long throw but misses the stump he aimed at (lower right). Upright stumps are 30 yards away, horizontal ones, 25 yards



Photographs by W. W. Morris

standpoint of averting "glass" arms, 11 ounces is the ideal weight for an object that is to be thrown. League baseballs weigh only half that much because a light ball means a fast game for the fans.) The best grenade produced by the British was the one they still use most, the Mills. Its cast-iron body was grooved externally to insure good fragmentation. It weighed a pound and a half and was filled with three ounces of amatol, an explosive mixture com-

posed of ammonium nitrate and TNT. When we entered World War I our Army Ordnance Department adopted the Mills grenade, redesigned its fuse mechanism to make it safer for the thrower, substituted nitrostarch-base Trojan explosive as the bursting charge, and started large-scale production. Orders were placed for 68 million; 21 million had been turned out when the war ended. A concussion-effect high-explosive [\(Continued on page 207\)](#)



Joan Fontaine and Arturo de Cordova make love on the deck of a seventeenth-century corsair in a scene from the Paramount Technicolor production, "Frenchman's Creek." Studio craftsmen re-created the ship "La Mouette" of the story, building it around the hull of an old schooner

Movie Shipwrights Build Pirate Ship

The Hollywood pirate ship on location at Albion Creek, in northern California. For authentic backgrounds, the 110-foot vessel was put on a barge at San Pedro, towed 600 miles



HOLLYWOOD'S ability to provide almost anything needed for motion-picture productions is demonstrated again in *La Mouette*, the colorful seventeenth-century pirate ship built for the new Paramount Technicolor picture, "Frenchman's Creek." For movie purposes, an authentic background was needed, so the ship was rolled onto a barge and taken 600 miles up the Pacific Coast from San Pedro to Albion, Calif. Here she was launched by flooding the barge's air tanks until it sank. Then a tug pulled the pirate craft up Albion Creek to her location for screening. The picturesque boat is 110 feet long, and it stands 25 feet high at the stern. It was built over the hull of an old schooner.



When Not to Pull the Rip Cord



Bailing out at low altitudes, a jumper need only count 10 before opening his 'chute. But at extremely high altitudes, where it is desirable for him to drop as fast as possible through the dangerously cold and rarefied air of the stratosphere, he can take time enough to say a three-minute prayer

Drawings by ERIC SLOANE

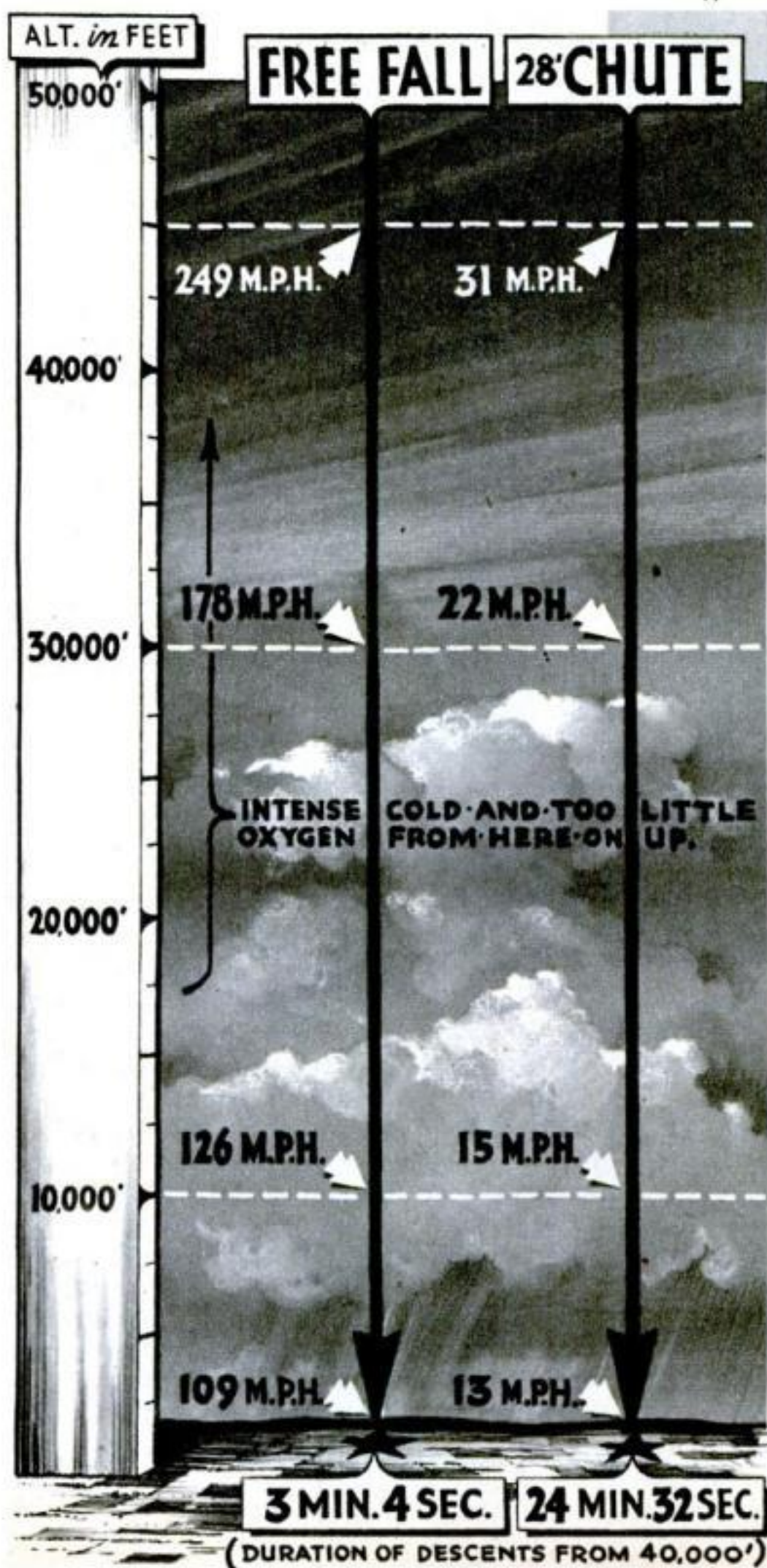
"COUNT ten before you pull the rip cord" used to be the parachutist's watchword—and it's still good at low altitudes, where the main object is to get clear of the plane. But when you jump from the stratosphere, there's safety in a good, long free fall.

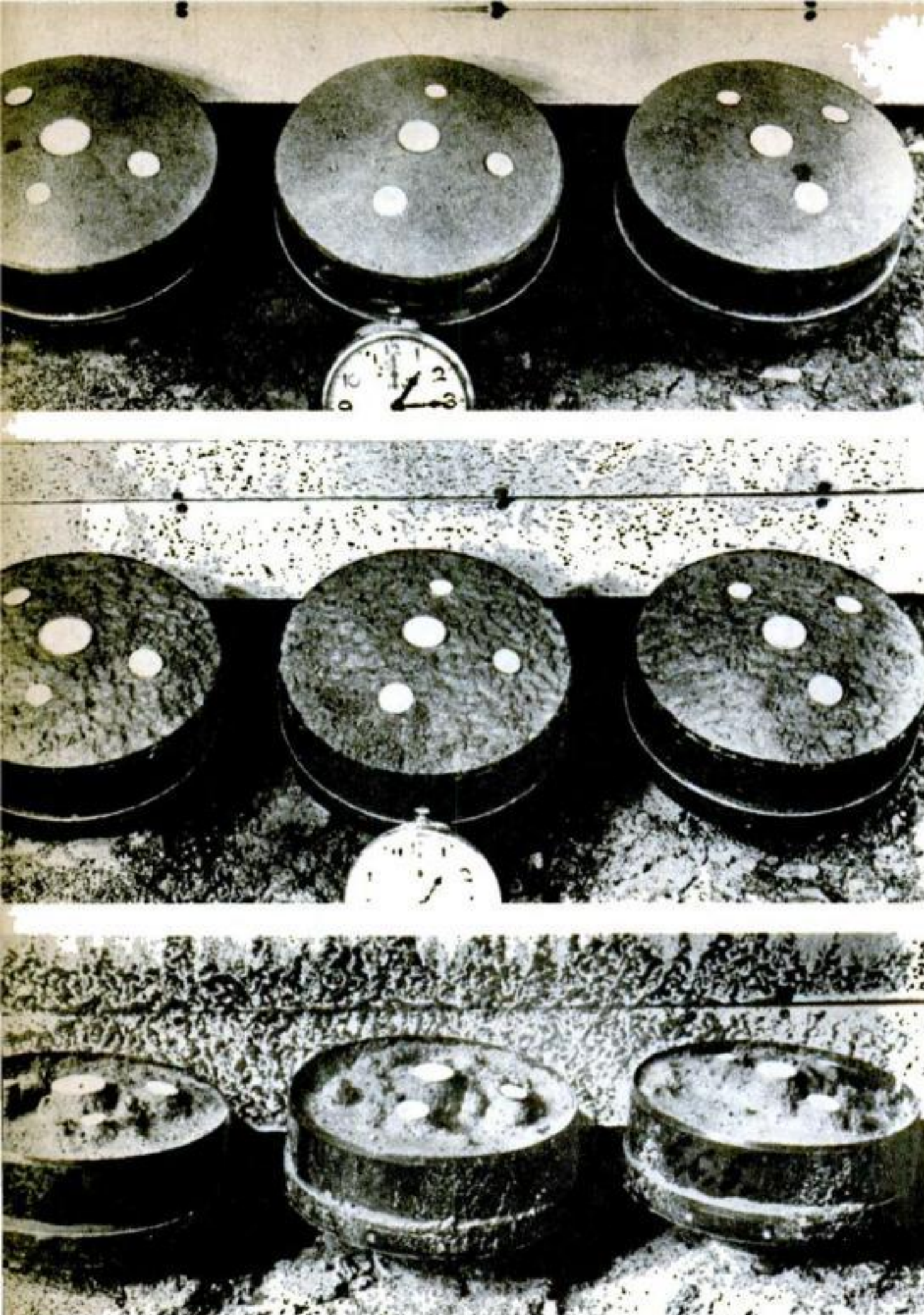
The reasons are shown in the diagram at the left. To begin with, a human body falls much faster through the thin upper air than through the denser atmosphere near the earth. At 45,000 feet, the speed is about 249 m.p.h., while near the ground it may be as low as 109 m.p.h.

If the high-altitude jumper opens his 'chute too soon, the shock of deceleration—sometimes twice as great as in an abrupt pull-out from a dive—can break his arms or legs, or snap his neck.

Another reason for a long free fall is found in the intense cold and rarefied air encountered above about 17,000 feet. If the jumper travels too far through this zone at the comparatively slow rate of parachute descent (22 m.p.h. at 30,000 feet), he will land in an exhausted condition, even with the protection of warm clothing and a bail-out oxygen flask. For fighter pilots there is an added inducement for a long free fall in that it gets them out of range of enemy planes.

The drawing at the upper left shows the proper "stance" for a free fall.





TESTS SHOW HOW RAIN DROPS CAN STEAL TOPSOIL

Soil samples, air-dried and screened, are placed six inches in front of a white splash board. Some coins are laid on top to shield part of the surface from the pelting of artificial showers from the rain-making machine

After just 45 seconds of "rain," the soil samples are pocked by the action of the drops. Splashes have carried soil to the splash board. Coins have not been displaced, but the surfaces of some of them have been muddied

Seventy-five minutes of rain of 6.6-inches-per-hour intensity, 5.1-mm. drop size, and 19.2-foot-per-second velocity has plastered the board with soil. Columns protected by coins show the original depth of the samples



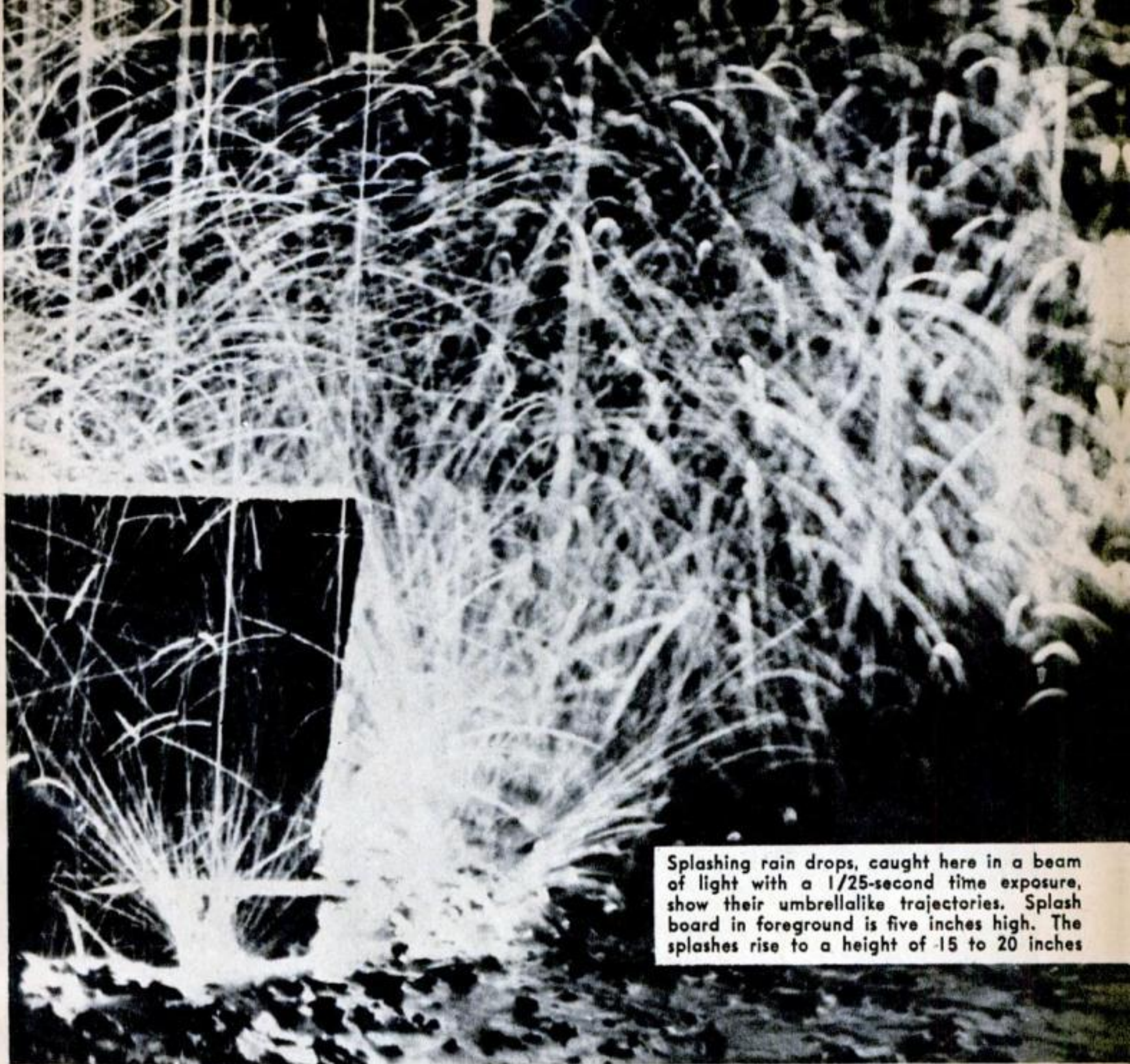
Tests Show How

Science gives the third degree to an innocent-looking culprit that costs us billions yearly.

TINY rain drops, pecking away at precious topsoil, are responsible for a considerable part of the estimated \$3,844,000,000 damage done every year in the United States by accelerated erosion. Exact measurement of this earth-moving action of rain is now afforded in experiments conducted by W. D. Ellison at the U. S. Soil Conservation Ser-

vice hydrological laboratory at Coshocton, Ohio. Putting the culprit through a scientific third degree, Ellison has caught, weighed, and analyzed the soil carried by a rain drop's splash.

When a rain drop smacks the earth, the Coshocton studies reveal, the resulting umbrella-shaped splash shifts a bit of soil. On sloping ground, the downhill curve of the splash is longer and heavier, and the drop also usually hits the slope with a sidewise, digging blow. This results in a considerable downhill movement of soil, even when there is little accumulated washing or run-



Splashing rain drops, caught here in a beam of light with a 1/25-second time exposure, show their umbrellalike trajectories. Splash board in foreground is five inches high. The splashes rise to a height of 15 to 20 inches

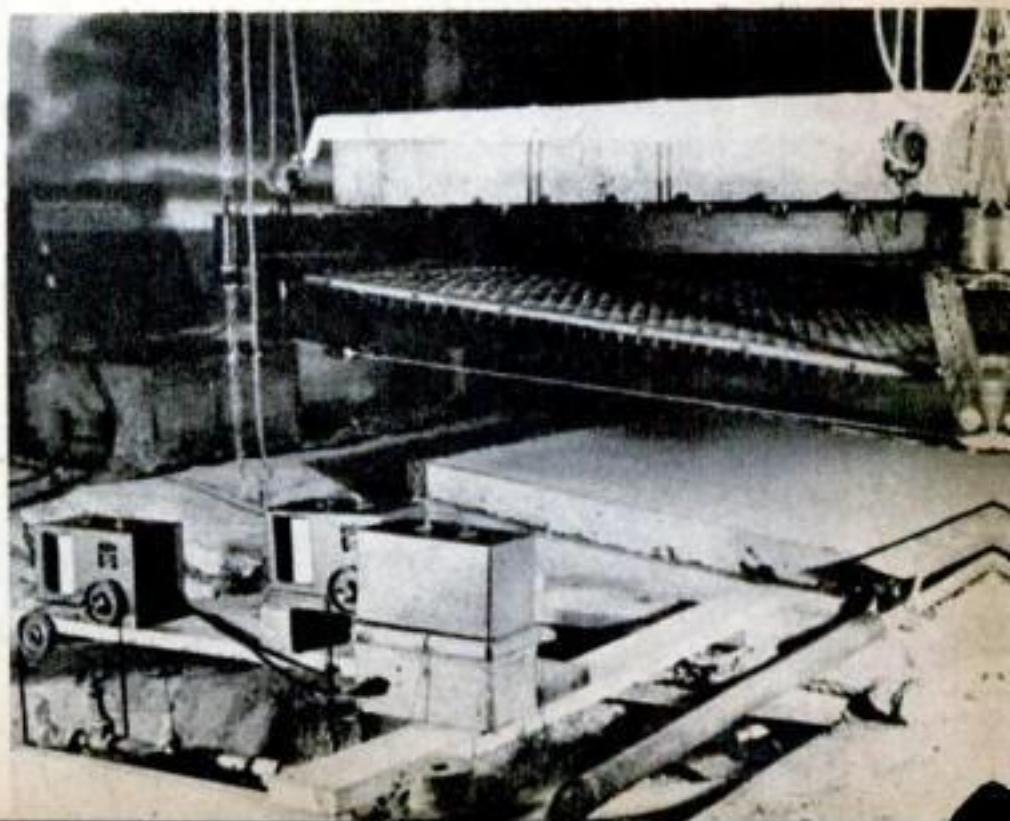
Rain Drops Move Soil

off. Ellison proved by test that the splash of a rain drop can travel as far as five feet.

To foil this thief of topsoil, the Department of Agriculture recommends the planting of low, broad-leaved varieties of crops, and the leaving of a mulch of leaves and stalks after harvest. Further tests promise to help the farmer find new ways of outwitting rain.

RAIN-MAKING MACHINE duplicates natural showers of any desired intensity, drop size, and velocity. Water seeps through holes in the bottom of a tank onto cheesecloth stretched loosely over chicken wire, drips off lengths of wool yarn

Photographs by U. S. Soil Conservation Service





ACCURACY in minimum-altitude bombing can be developed through gun practice (above) since, in a P-38, both bombs and guns are aimed with the same sight. Housed in the left bomb-rack fairing of the P-38 below is a 16-mm. movie camera which automatically begins to "shoot" the instant the pilot does. By photographing the plane's tracer bullets and the bursts of its cannon shells, it provides a record of the hits and also identifies the target. Note tiny window through which camera peers



WHEN FIGHTERS TURN BOMBERS

How American flyers developed a new technique for needling the enemy. . . . Rocket planes vs. minimum-altitude bombers.

By
HAL BORLAND

Drawings by STEWART ROUSE

TECHNICALLY it is known as minimum-altitude bombing. What it adds up to, under any name, is flipping a bomb into a target from close range and at high speed, using the plane as a kind of flying catapult. Skillfully done, it is devastating. And we have dozens of skillful minimum-altitude bomb tossers. They sank 22 Jap ships in the battle of the Bismarck Sea. They ripped Nazi supply lines and harried the tank columns up the Italian boot and across France. On the Pacific islands, they tore Jap defenses to pieces and battered airfields, supply columns, and troop concentrations.

Since the development of rocket launchers for planes, some of the jobs of the low-altitude boys have been taken over by Thunderbolts and other fighters fitted with rocket projectors. For some kinds of work rockets are better, but the treetop bombers still have a definite place in the picture.

Nobody knows for sure where the idea came from. Several pilots had noted that when a bomb is released from a fast plane at low altitude it follows a fairly flat trajectory, hits the ground, and skips. But nobody did much about it until the summer of 1942 when Brig. Gen. Grandison Gardner, commandant at the proving ground of the Army Air Forces Proving Ground Command in

NOVEMBER, 1944

Photographs by
HANS GROENHOFF

TREETOP BOMBING



Scraping the birds' nests, a Lockheed P-38 Lightning swoops toward its target. The trees lend concealment



In the open, altitude may be as little as 20 feet. In actual combat, it would use its guns as well as bombs



Bomb away! The "egg" follows closely the flight path of the plane. Below, the bomb explodes after the plane has passed. Low-power charges are used in bomb practice





ADVANTAGES OF MINIMUM-ALTITUDE BOMBING



A NEAR MISS with a heavy bomb can be almost as effective as a direct hit. While rockets can demolish even massive installations, their comparatively light explosive charge calls for bull's-eye accuracy if they are to do their job



AVAILABILITY of bombs almost anywhere favors their use. Since the fighter-bomber uses the same kind of missiles as the regular mediums and heavies, it can be loaded from the supplies that are to be found at practically any air base

BOMBING a bridge from a minimum altitude is a ticklish job, because the plane must fly directly at the pier until the bomb is released, then climb sharply. The fuse gives about four seconds' grace

Florida, began to have notions. He and Col. Sargent Huff, of Ordnance, went to work, looking primarily for a way to bomb tanks effectively. They had the pilots, the planes, and the bombs—and it wasn't long before they had a technique. Training for this type of bombing was advanced at the AAF Tactical Center in Florida.

Officers from the fighting fronts returned to the Tactical Center to work out problems, to learn new tactics, and to instruct other officers. Combat veterans showed those officers what could be done with their new bombing method. They went back to their commands, and in a matter of months both the Japs and the Nazis got their first taste of minimum-altitude bombing.

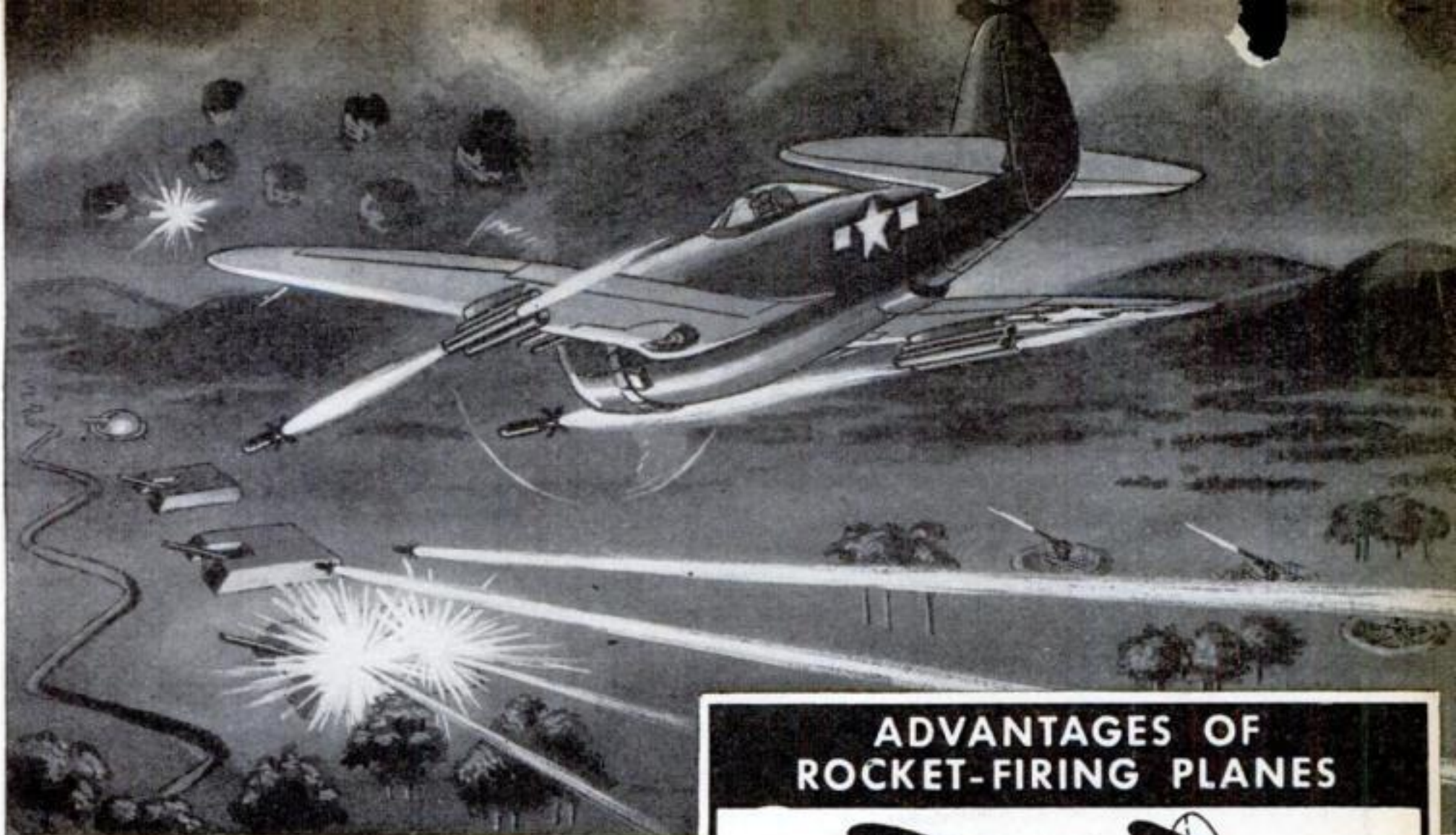
One Air Force captain who did months of minimum-altitude bombing in the Pacific sums it up this way:

"It is highly effective because you can use any type of fast, maneuverable plane. You can use any size bomb, from the little frags (fragmentation bombs) up to 1,000-pounders. It is deadly against airdromes, lines of communication, shipping, railroads, highways, and trails. On the battlefield it can knock out tanks, troops, or gun emplacements. Surprise is the primary advantage; you come in so low and so fast that detectors have trouble picking you up. Defensive aircraft can't get you without risking ground crashes. Heavy ack-ack guns can't depress low enough or fast enough. Your accuracy is exceptionally high. And

Our Cover

How a 1,600-pound armor-piercing bomb is fitted to the rack under the left wing of a P-38. In the bomb-rack fairing is the tiny window through which a camera peers to record kills in combat





ROCKETS can be used effectively to demolish a chain of gun emplacements, as illustrated here with a P-47 Thunderbolt. Since the projectiles hit ahead of the plane, the pilot can correct his aim

you can bomb and strafe on the same run, a combination that's hard for any enemy to take."

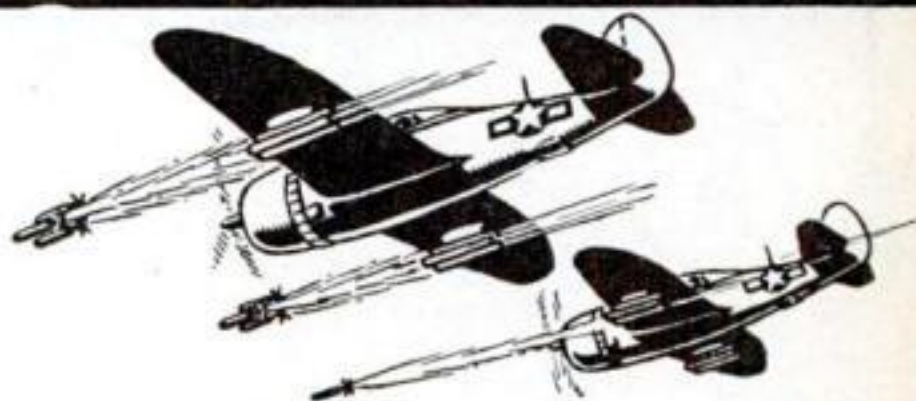
The ideal low-level bombing approach is at treetop height and at speeds up to 300 miles an hour. It is most effective in a rough, wooded country. The Pacific islands are perfectly suited to it, and the boys out there go darting up the valleys like swallows, to pounce onto Jap airfields at 20 feet altitude or even less. There they cut loose with all guns in a strafing attack just before they begin to flip their bombs at the targets.

Two types of bombs are used. One is the ordinary bomb such as might be dropped from high-altitude, precision bombers, but equipped with delayed-action fuses that set them off about four seconds after contact. This delay is essential for the bomber to escape the bomb blast. The other type is the parachute bomb, usually a cluster of fragmentation bombs with an eight-foot parachute to slow it down; this type uses an ordinary contact fuse.

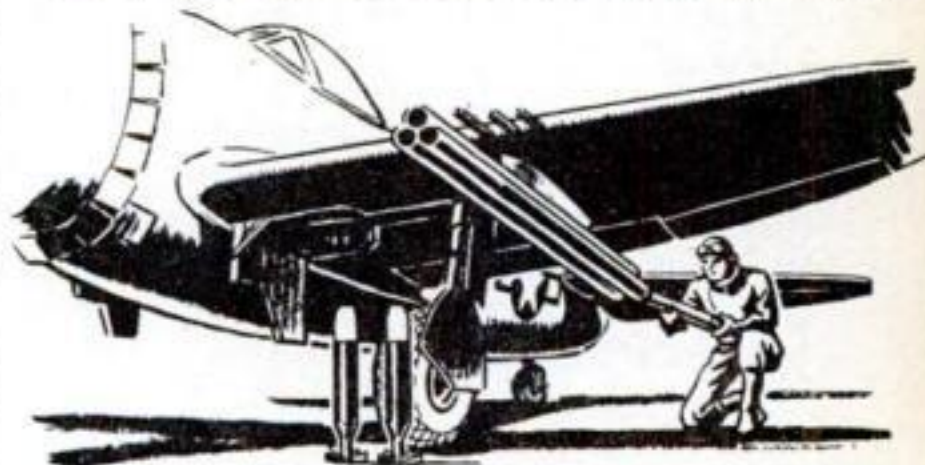
The bombing approach is usually devious. The bomber will often approach his objective from downwind, literally running ahead of the roar of his motors. His bombing run is seldom more than a few seconds.

The first minimum-altitude bombers on the African desert had their troubles as soon as the initial surprise wore off. The desert offered little cover for their approach and they were quite visible from the air, open to dive-strafing. But that problem was

ADVANTAGES OF ROCKET-FIRING PLANES



SELECTION OF FIRE. Any number of rockets, from one to the total supply carried, may be fired at a time. This enables the pilot to accommodate the striking power to the target. Also, it may give him another chance if first try misses



EASY LOADING. Arming a rocket plane does not require loading cranes or abundant manpower. If necessary, the pilot himself can fill the tubes with projectiles. Rocket fins fold forward for insertion in tube; wind pushes them back when fired

largely solved when somebody got the idea of painting their ships a pink sand color, which made them blend with the desert. Then they really went to town against Rommel's tanks.

They ran into other troubles when they began to rip Rommel's Mediterranean supply line to pieces. The ships were easy enough to get, *(Continued on page 205)*

NEW CHEMICAL MAGIC MAKES WATER FLOAT ON OIL

Now We're Winning the War on Rust

By VOLTA TORREY



Rust-preventing oils can do the "impossible." When dropped on metal on which water has also been placed, the oil, instead of floating on the water, burrows under it and lifts it from the metal to prevent corrosion

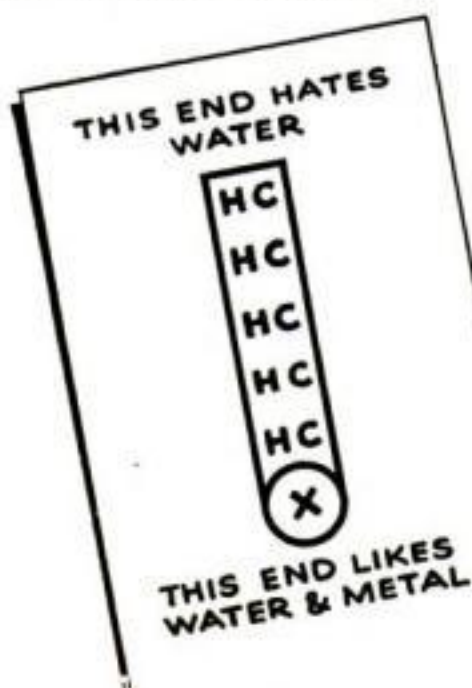
TO WAGE this war, Americans have had to defeat a much older, stealthier, and more persistent foe of civilization than the Japs. This enemy is rust.

It is a greedy and relentless saboteur of both swords and plows. As men have made more use of metal, losses resulting from rust have risen to billions of dollars a year. The British Iron and Steel Institute estimates that rust has claimed 40 percent of the 2,000,000,000 tons of pig iron produced in the half century between 1890 and 1940. Others declare that rust has done more damage than both fires and floods.

Rust is a reversion of metal to one or another of the forms in which it originally was found in the earth. Iron tends when wet, for instance, to unite chemically with oxygen and become an ore again. Water and oxygen

WHAT IS A POLAR COMPOUND?

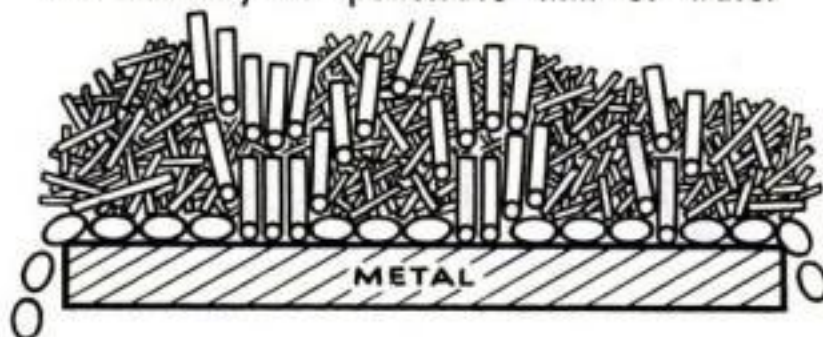
By adding atoms of nitrogen, chlorine, oxygen, or some other appropriate element to the hydrogen and carbon of oil, molecules of the oil are given a polarity in which one end is hydrophilic, or fond of water or metal, and the other end is hydrophobic, or averse to water



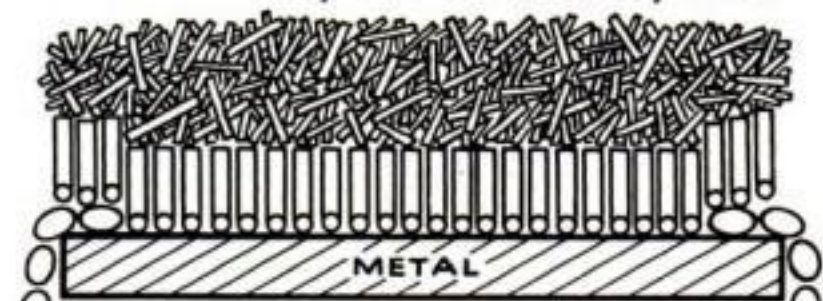
HOW NEW OILS SEPARATE WATER FROM METAL



An ordinary oil, when placed on wet metal, is unable to prevent corrosion because of its inability to penetrate film of water



When polarized, oil molecules move toward metal, hydrophilic ends first, pushing water aside as they advance. Note key below



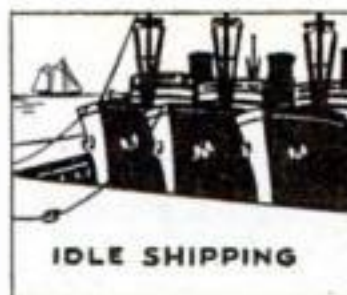
Here invasion is almost complete. Hydrophilic ends are attached to the metal; hydrophobic ends hold rest of oil to the metal

KEY: OIL WATER POLAR COMPOUND

are the most important single cause of rust, but it also may be caused by acids and fumes. Salts are catalysts that hasten it. So rust, in fact, may be caused by almost anything from a fingerprint to an ocean wave.

Some kinds of metal are less vulnerable than others. The corrosion of certain metals has long been known to form a coating that prevents further deterioration. Recent research has traced the ability of nickel to resist corrosion to the arrangement of electrons in its atoms. Stainless steel and many alloys that are impervious to rust have been developed and more such products may result from the exploration of atoms. Much progress has been made, too, in coating metals that are susceptible to corrosion with sturdier stuff. Plating processes and protective paints have been used for many years to forestall rust, and such methods are still being improved.

Even so, some vital parts of modern engines, guns, and other machines still must be made of vulnerable metal that cannot be shielded from rust in any of these ways.



VITAL POSTWAR JOBS FOR NEW OILS

After the war, rustproofing oils will protect the householder's tools, will extend the life of wartime vessels awaiting new uses, will safeguard farm equipment that has been put up for the winter

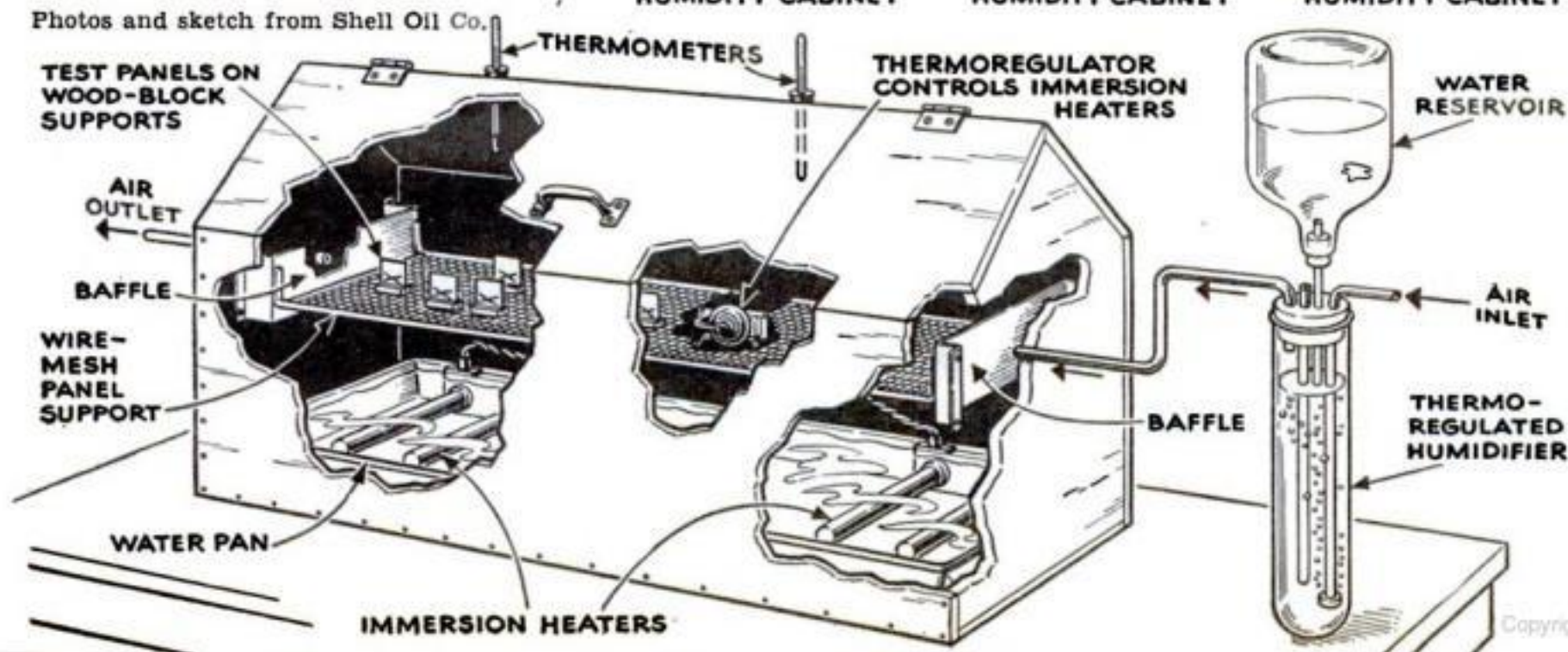
These chinks in the armor of civilization might have proved fatal during this war if new means of checking corrosion had not been found in time.

World War I methods were not satisfactory; rifles sent to France then were coated with thick grease that took time, toil, and sweat to remove. This time, more complex weapons, ready for almost instant use, were required at more distant points under more hazardous conditions. Protection against corrosion has been needed in both the gnawing 130-degree heat and humidity of the tropics and the biting 40-below-zero cold and fog of the Arctic. Salt spray and engine fumes also have menaced precisely

PREVENTING CORROSION FROM FINGERPRINT STAINS

One of the most important jobs of rust-preventing oils is to remove the acids left by fingerprint stains. Precision-made parts of war-needed materials can be ruined by corrosion resulting from the mere touch of a worker's fingers. To prevent this waste, which in some instances has ranged as high as 25 percent, studies have been made of the corrosive action of moisture from human hands. Women's fingerprints have been found to be more likely to cause rust than those of men, while the touch of an Italian's or Greek's hand is thought to be more corrosive than that of a northern European. For experimental purposes, investigators have developed a synthetic fingerprint liquid which is applied to metal that is then placed in a humidity cabinet (shown in diagram at the

bottom of the page) to speed corrosion. Below, left, a metal piece untreated with oil is shown after one hour and after 24 hours in the cabinet. At right, a metal piece that has been treated only with ordinary mineral oil. Fingerprint-stained metals that have been dipped in rust-preventing oils have stayed in the cabinet for hundreds of hours without corroding



made mechanisms. Matériel has been shipped as deck cargo and landed on damp beaches. If a single, sensitive part of a costly machine rusted, all the time and manpower devoted to making and shipping the whole machine might go for naught.

No one sure way of preventing all kinds of rust has been discovered. Selection of the wrong method, the Army has found, may actually hasten rather than retard rusting. But grim necessity has sped the perfection of many new preparations and new techniques which, when properly used, are extremely effective.

Oils that inhibit rust by marching under water and forming a protective film on metal are an intriguing example. If you dip a piece of easily corroded metal into sea water, remove it, and cover the metal with ordinary oil, tiny specks of rust may appear on it in a few minutes because of the moisture remaining beneath the oil. But if, after dunking the metal in sea water, you immerse it in oil containing one of the new rust inhibitors, no rust will appear.

You can see why without a microscope. Put a drop of sea water on a clean piece of metal. Then place a few drops of oil containing the rust inhibitor near by. When you jiggle the metal slightly, the drop of water will be lifted from the metal by oil creeping under it. This replacement of the moisture by oil on the surface of the metal averts rust.

Even though the water is heavier than the oil, it will not seep through the oil and corrode the metal. It will be stopped by molecules which you cannot see but which have been mobilized by the chemists as military police to keep water away from metal.

These molecules are synthetic substances known as polar compounds because of their chemical peculiarities. Like other molecules of oil, they are chains of hydrogen and carbon, but atoms of oxygen, chlorine, nitrogen, or some other element have been added to them. This makes them behave like little soldiers. Thinking of them as tiny troops, in fact, may help you understand what the chemists believe occurs when oil containing these compounds is applied to metal.

The addition of appropriate atoms to these molecules seems to make one end of each hydrophilic, or fond of water, while the other end remains hydrophobic, or averse to water. The hydrophilic end is drawn to either water or metal. But the hydrophobic end continues to cling to the other molecules of oil.

When oil containing polar compounds is put on metal, these little soldiers advance and plant their hydrophilic feet firmly on or in the surface of the metal. The hydrophobic ends bring the rest of the oil along

PACKAGING A P-51

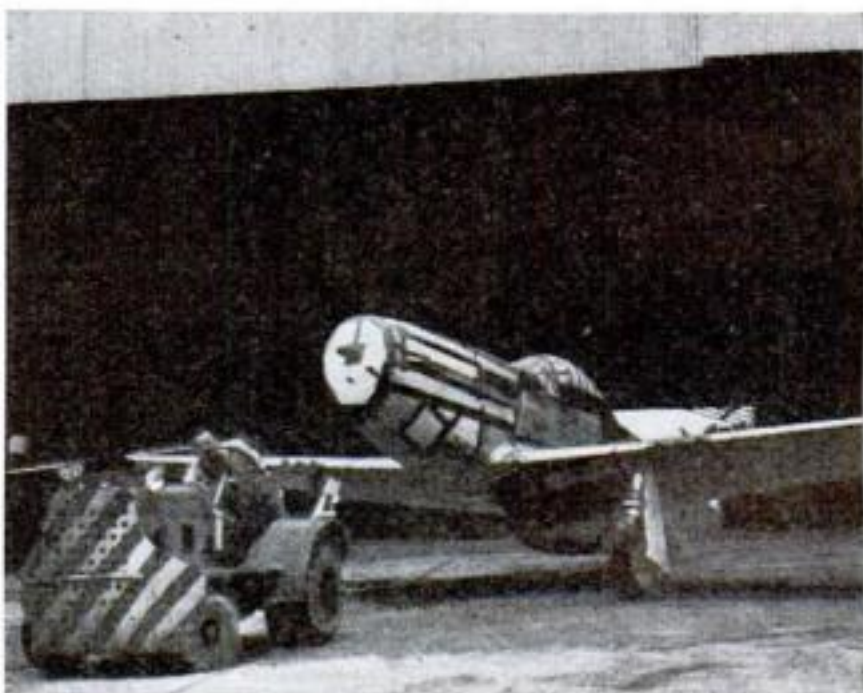


1 Ordinary gas and oil are first replaced with a clear octane and a rustproofing oil. Engine is run for 20 minutes, drained, blown free of fumes

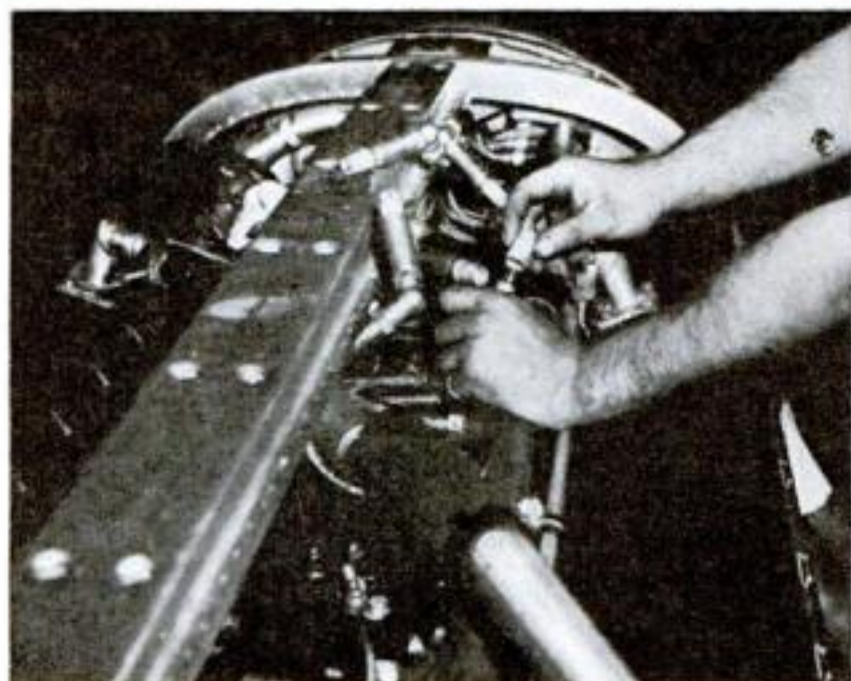


4 Guns come out of the wings, are given a heavy coat of rust-preventing oil, then reinstalled. Eight different oils are used to protect the ship

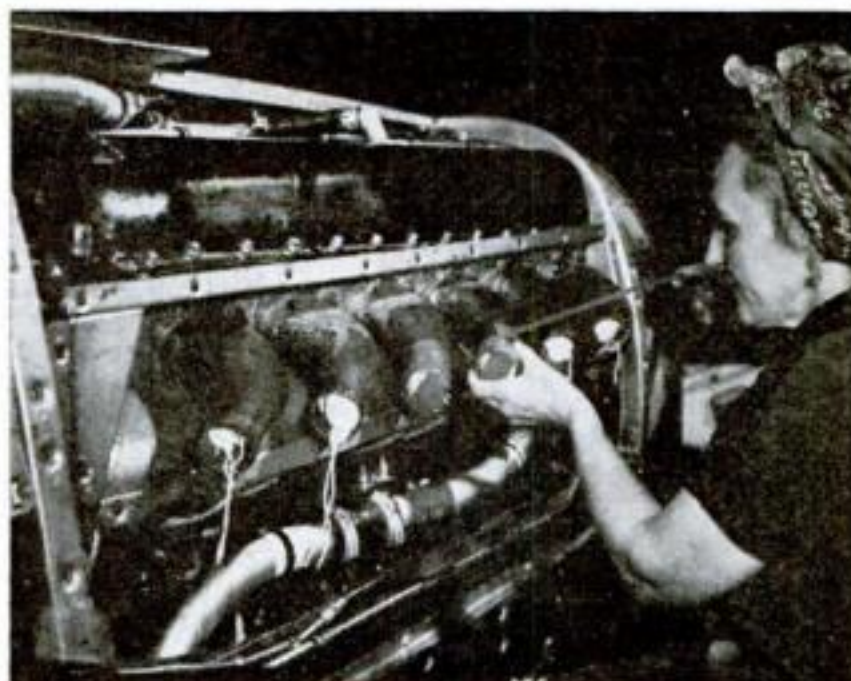
7 Thoroughly cleaned and airtight, the plane is towed out to get its final wrapping. All open interior spaces have been given a coating of oil



TO SAFEGUARD IT FROM RUST DURING SHIPMENT OVERSEAS



2 Spark plugs are replaced with adapters (as in worker's fingers) to which are attached small moisture-absorbing tubes of silica-gel crystals



3 A sack of silica gel also goes into each of the engine's exhaust stacks, which are then sealed with tape that is wound tightly around their ends



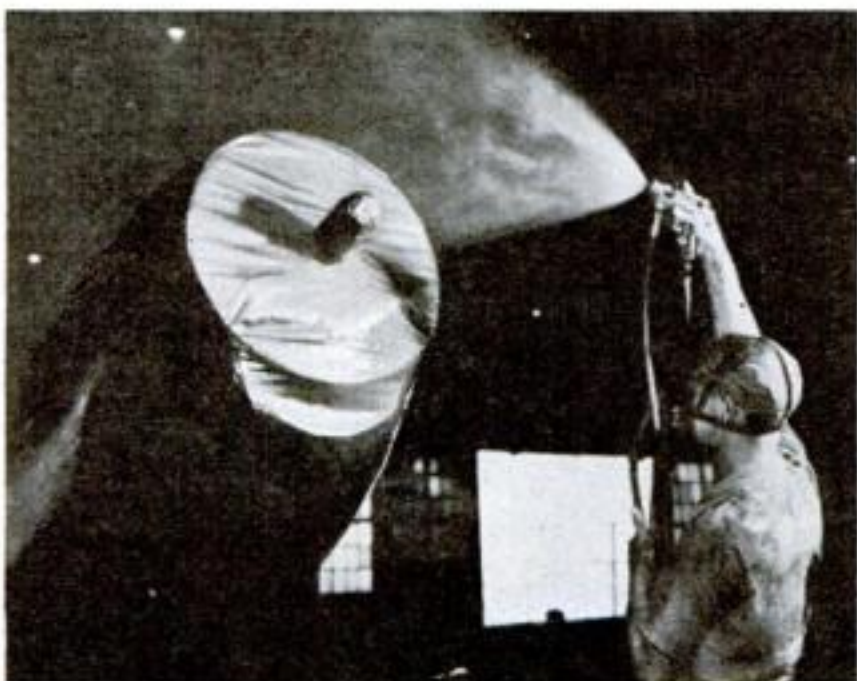
5 After wing tips are removed, openings are covered with plywood. Other openings left by removal of protruding parts are similarly protected



6 Instruments are not removed from the ship but are wrapped in oilcloth; tightly taped. Silica-gel bag is hung in cockpit, which is then sealed

8 A waterproof overcoat of either grease or plastic, 8/1,000 of an inch thick, is then sprayed on. Spray dries and hardens quickly, is not sticky

9 Ready to sail. On arrival, the ship's overcoat can be peeled off in a few seconds, and its individually wrapped parts reassembled in a few hours



behind them, and thus bind the oil tightly to the metal.

If there's a drop of water in the way, a company of these military police will surround it and anchor themselves to it with their hydrophilic feet. To do this, they will kick it away from the metal, and hold it off the metal with their feet. Some of them may have to stand on their other ends to do this, but they do it very well.

There are many kinds of polar compounds that can be put in oil to separate moisture from metal. Different compounds are used, in varying amounts, in different kinds of oil, depending on the job to be done. A preparation for use indoors, for instance, may not be satisfactory outdoors. So producers of rustproofing oils have long lists of preparations, and the correct one must be chosen to obtain the best results.

One of the most important uses of polar compounds is to remove fingerprints. In many machines, nowadays, key parts must not be more than a ten-thousandth of an inch larger or smaller than specified. Such parts can be rusted and ruined by the mere touch of a man's finger.

The rotor shaft in a directional gyroscope is one of these delicate parts. Although the metal in it is worth only a few cents, the finished shaft is worth as much as a skilled mechanic earns in a day. Two thousand of these carefully made shafts once had to be discarded because of tiny specks of rust. Rejections of precision parts for weapons have run as high as 25 percent. In some



Courtesy of Standard Oil Company of New Jersey

In the vessel at right, a wet piece of metal has been dropped into ordinary petroleum oil, but because the oil can't displace the water, rust is already beginning to form. The rust-preventing oil in the left vessel, however, has crept under the water to form a protective film

plants, inspectors now examine such parts with microscopes.

Rust resulting from contact with human beings, consequently, is now being studied intently. Women's fingerprints have been found to be more likely to cause corrosion than those of men. Some investigators also believe that the fingerprint of an Italian or Greek is likely to be more corrosive than that of a northern European.

To test and perfect ways of removing fingerprint stains from metal, a synthetic fingerprint liquid, containing the following ingredients, has been produced:

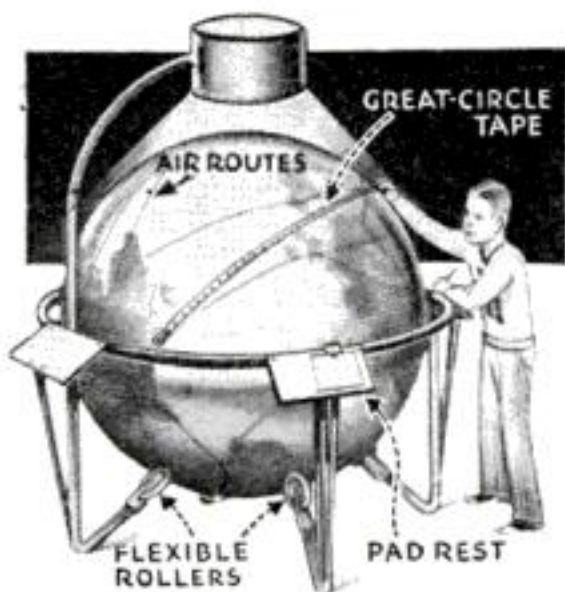
	(percent)
Salt (sodium chloride).....	0.63
Urea	0.09
Lactic acid	0.36
Water	11.45
Methanol	87.47

The liquid is applied with a brush to the metal, which is placed in a humidity cabinet to speed up the damage.

If not protected by an oil containing polar compounds, the metal may be seriously corroded in this cabinet within an hour. But the same metal, covered with the synthetic fingerprint solution, then dipped in oil capable of lifting that mois- (Continued on page 208)



Ball bearings used in gyroscopic instruments made by General Electric are kept under glass until used; are picked up only with tweezers; never touched by hand. Oiling with special fluid is done with hypodermic needle



In the free-rolling spherical map, small holes may be drilled through the major cities of the world so that the hooked end of a tape measure can be inserted in them for determining global distances

WHETHER we like it or not, the airplane is lifting us from a smug two-dimensional world of charts into a round world of three dimensions. If we had not depended too much upon charts before Pearl Harbor, we would not have had a false idea of the position and importance of the Hawaiian Islands; Alaska would have loomed up as near to the Orient as it really is. One of the most important jobs for Americans of tomorrow will be to orient themselves to the rest of the world—to see our land as our global neighbors see it.

Tomorrow's geography classrooms will be without the familiar wall maps, but will be built around giant-sized, free-rolling globes. Only such a globe will give the proper feeling of space. By turning the globe upside down, the student will escape the false idea that north is "up" and south is "down"; he will lose the cramped feeling that all nations spread out from his; he will be able to view his shores exactly as his earth-neighbors do. Geographers admit that no flat map can even nearly give a true picture of the earth; why then, should schools continue to teach global geography from this type of map?

Look at the drawings above. If you are "of air age" you will be able to answer most of the tests correctly. Can you recognize the picture of North America when it is up-

BACK TO A ROUND EARTH

AIR AGE CALLS FOR GLOBAL GEOGRAPHY

By ERIC SLOANE

TEST YOURSELF

Which of these statements are true? After getting your answers, check them with the upside-down line below

by SLOANE

The earth bulges at the equator and is really an oblate spheroid.

The North Pole is nearly 1,500 miles from the North Magnetic Pole.

Direction of Tunisia from U.S. is along arrow "B."

The Hawaiian Islands are nearer Alaska than Mexico.

Maine is closer to Africa than Florida is.

A great-circle course is just a straight line on the globe.

This familiar (?) body of land is the home of the Brooklyn Dodgers.

OVER 90%
Nearly everybody lives in the Northern Hemisphere.

Death Valley is farther north than Little Rock, Ark.

From the U. S., Tokyo is in the direction of arrow "B."

From Atlantic to Pacific, Panama Canal runs south and east.

Canada is nearer to South America than Arizona is.

Believe it or not, every one of these statements is correct!

Drawings by the Author

side down, as the Arctic-route flyers will approach it? Can you realize that three fourths of the earth is covered with water? With all this volume of water, if the earth were absolutely smooth, all the land would be completely covered to a depth of 1½ miles.

Such comparisons, readily seen and completely understood through the study of a giant spherical map, are not easy to "feel" when looking at a flat map.



TERMITES LIKE MONEY. And the man who banked \$6,000 in bills under the wooden rafters of his house provided an expensive meal for the insects. He sent the remains to the U. S. Treasury Department's Currency Redemption Division, and in two afternoons one of their experts identified \$4,600

-BUT DON'T SEND ASHES!

**How Treasury sleuths identify
charred, rotted, termite-eaten,
and otherwise mutilated bills.**

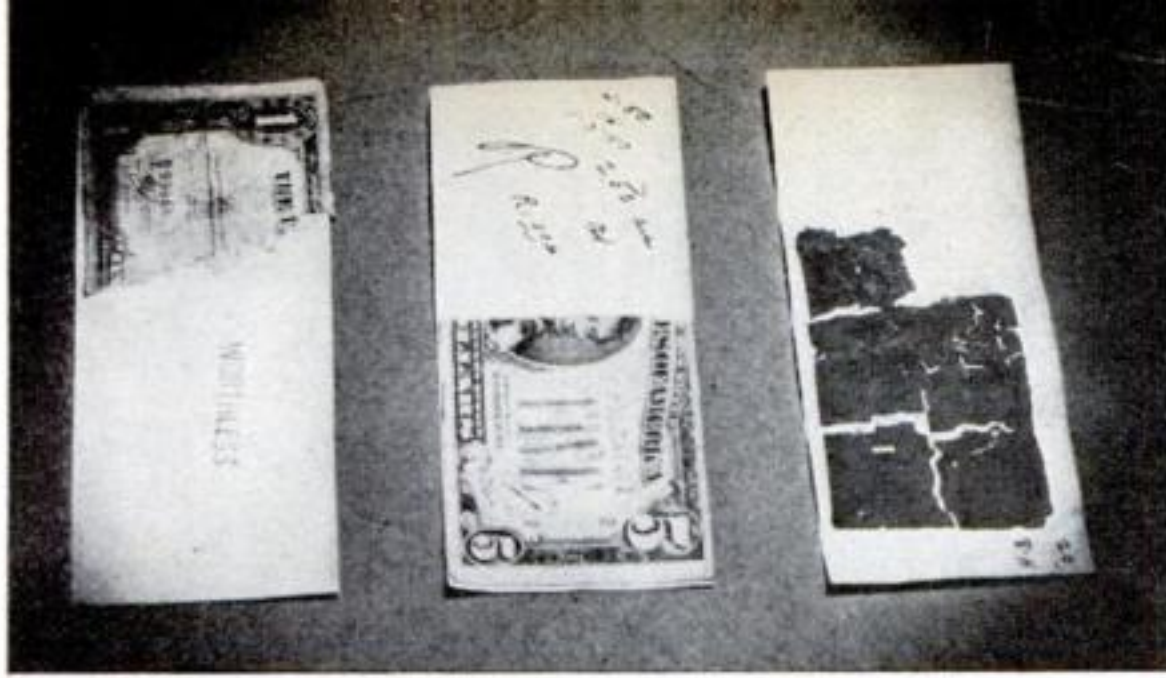
By LAURENCE D. SMITH

Photographs by WILLIAM MORRIS

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ABOUT the time of the Japanese attack on Pearl Harbor—or, to be more exact, on November 30, 1941—there was \$9,903,355,066 of currency in circulation, exclusive of the holdings of the Treasury, the Federal reserve banks, and agents. On July 31, 1944, \$22,526,812,783 was in circulation. This enormous increase has directly or indirectly affected the lives of all Americans; but it has affected no one more intimately than it has the remarkable ladies of the Treasury Department's Currency Redemption Division, Washington, D. C.

In time of peace, these women were already burdened with the most trying and nerve-racking sort of work, the identification of mutilated money. Now their labors have more than doubled—partly because of the increase in the amount of money in circulation, but also because wartime casualties greatly swell the volume of notes sent in for redemption. A half million dollars was received from a single ship damaged at Pearl Harbor. Unhappily, the labors of these cheerful though harassed ladies cannot be lightened by adding to the personnel. Many years of training and experience are needed to develop their unique skill. They have the ability to perform feats of wizardry that a professional magician might envy.



WHAT MUTILATED MONEY IS WORTH. Because it is less than $\frac{2}{5}$ of the original note, the fragment at the left is worthless. More than $\frac{2}{5}$ but less than $\frac{3}{5}$, the fiver in the center rates \$2.50. With more than $\frac{3}{5}$ identified, the charred remains of a twenty at right are redeemed at \$20

The presiding genius of these uncanny workers is Bertha Walker. On the day I called at Redemption Division she was seated at her desk with some hundred-odd bits of coal-black char spread out before her, and other thousands of fragments in pasteboard boxes.

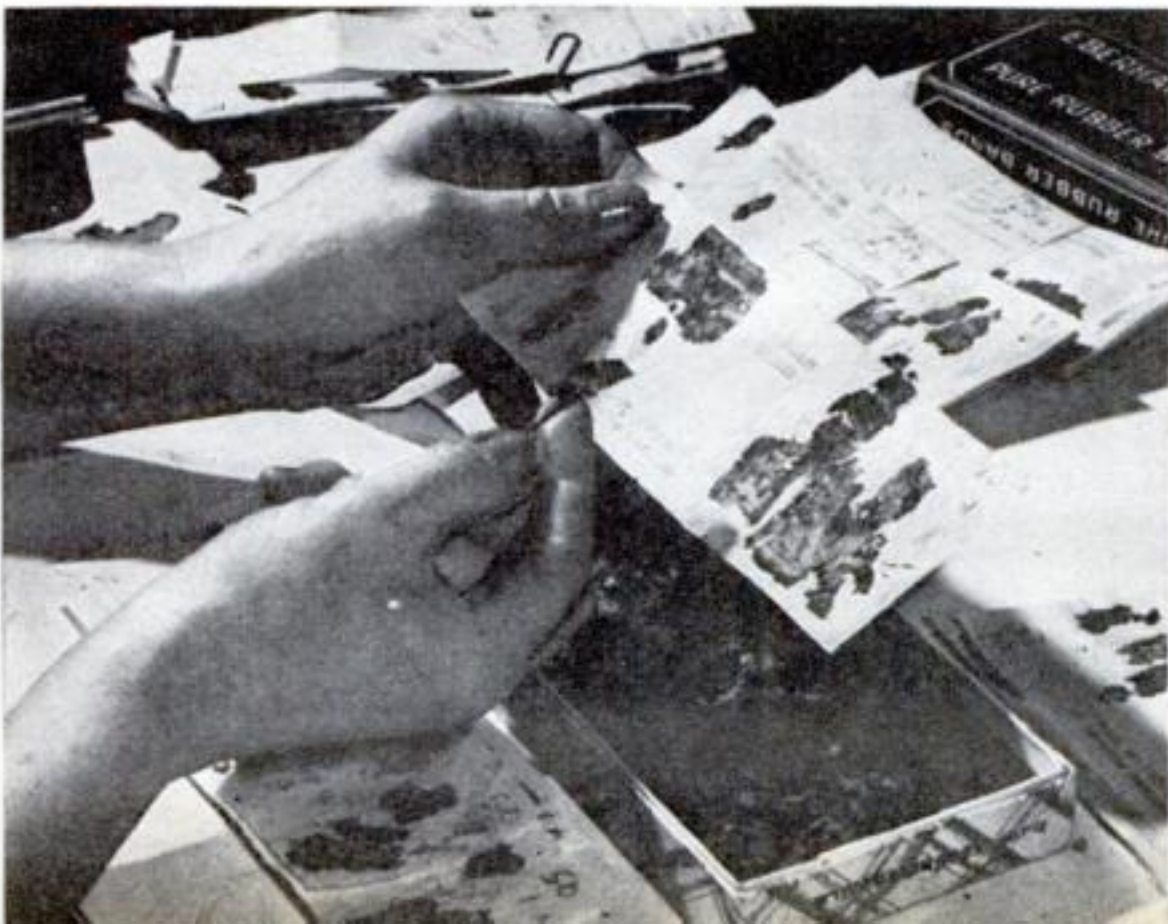
"These charred remnants were sent to us in April," she explained. "There's supposed to be \$1,520 here.

"A house in a small town out in Montana burned to the ground. The money was in a purse on the second floor and the flames spread so fast that it couldn't be retrieved. So far, I've identified quite a few tens and twenties, but no fives yet."

That she could identify even a single fragment seemed miraculous. The remnants looked like crumpled bits of plain black tissue paper and flakes that would float off if you spoke above a whisper. No trace of the design remained, so far as I could see, even with a magnifying glass.

"First I sort the charred remnants according to denominations," Mrs. Walker continued, "and mount

ROTTEN MONEY is definitely an unpleasant sight. When bills have been buried in the ground, they mold, decay, and often form a compact mass that is extremely difficult to separate into identifiable remnants. Here are the skillful hands of an expert reconstructing the remains of molded buried money



WHAT THE U. S. TREASURY DOES WITH WORN MONEY

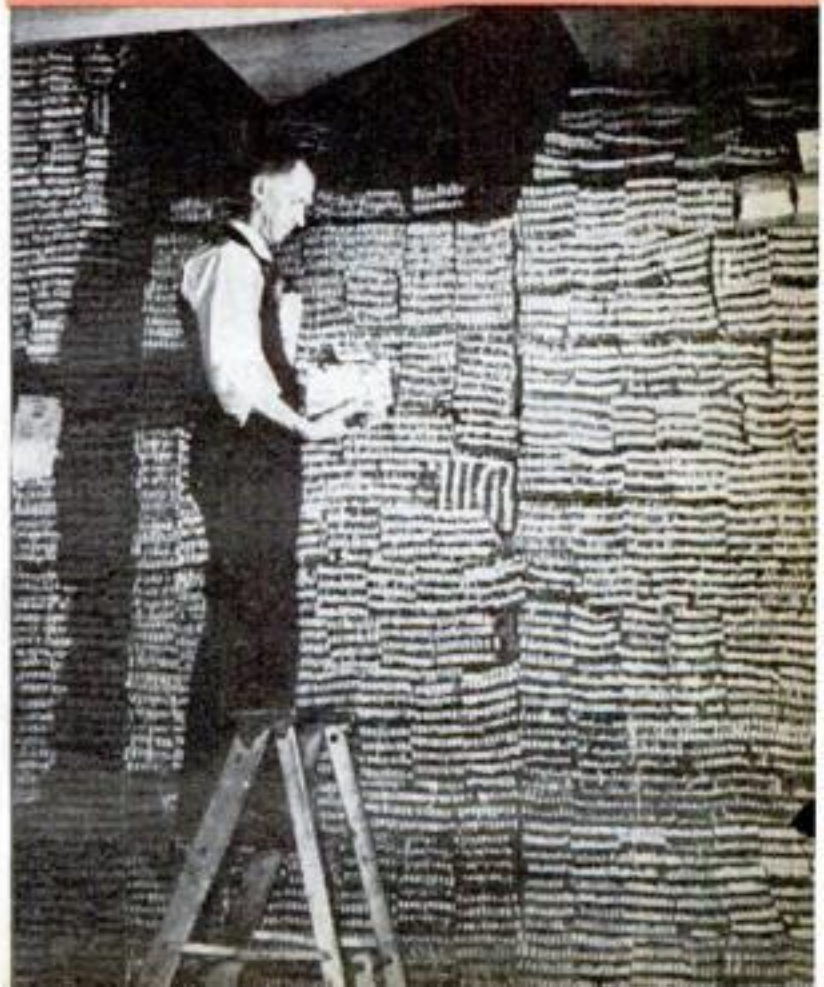


1 Worn notes received from banks are sorted and classified according to their type. "Fit" notes are then returned to circulation but the "unfit" are destroyed according to law.



2 A powerful chopper is used to cut the pile of bills in two lengthwise, after which the halves are carefully packaged in 1,000 lot

3 Bundles of cut-in-half notes are stacked to await removal to the incinerator for burning in the presence of two Treasury officials.





IRRATIONAL BANKS. They are (top) a decayed shoe in which \$230 was buried; a moldy eyeglass case and wallet (center) that were plowed under by a farmer; and (bottom) a section of pipe closed with screw caps at ends

them on these oblong pieces of paper. They're just a speck larger than the bills."

With tweezers she picked a larger fragment and placed it on one of these papers, and another on a different piece of paper. This went on for several minutes. Only rarely did she use the magnifying glass.

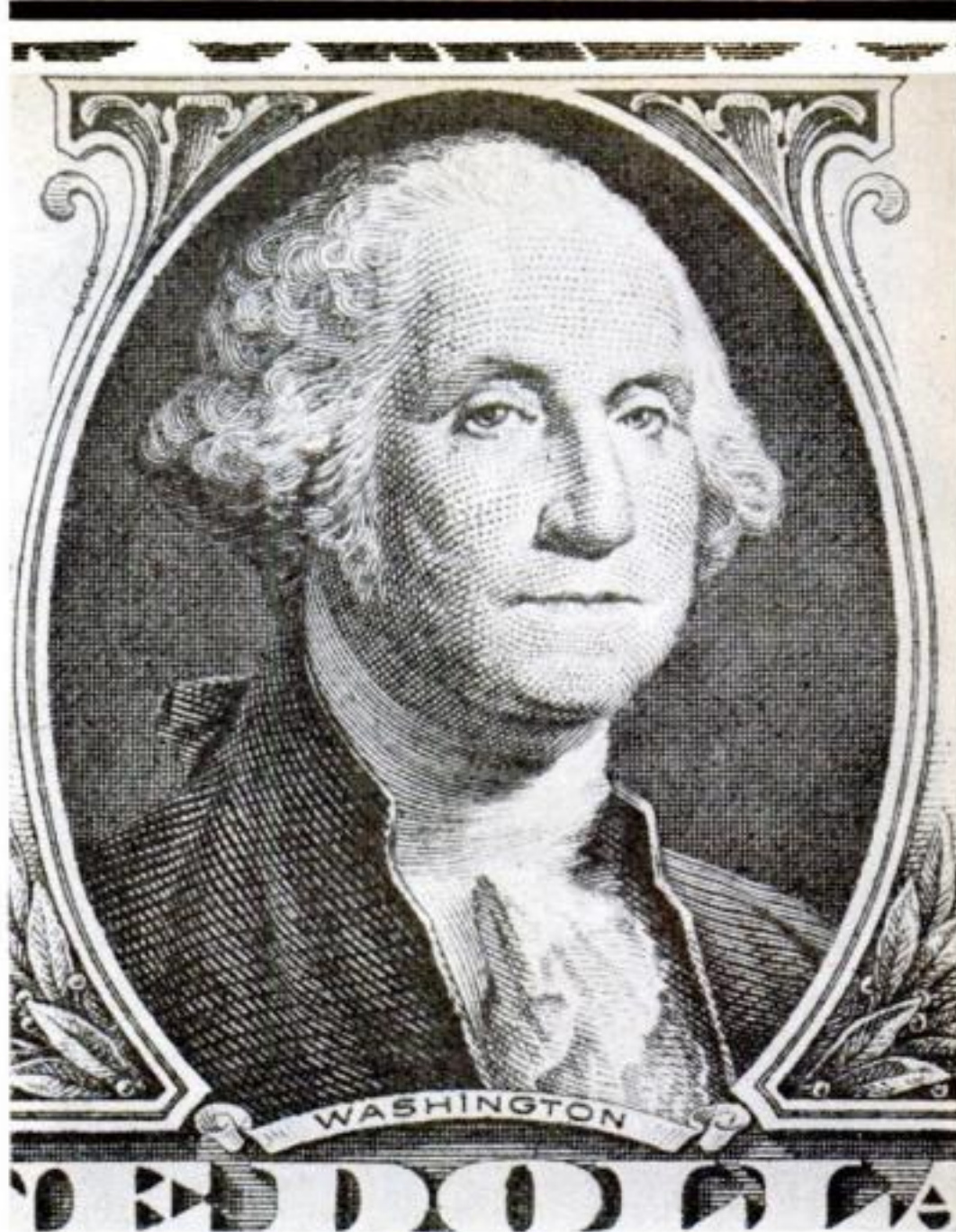
Now, apparently satisfied with her selections, she pasted a piece of char on the paper—another and another. Her fingers worked rapidly. She put the papers between blotters to remove the moisture. She picked up a tiny particle, studied it, and put it back. She picked up another bit and pasted it three inches from its nearest neighbor.

Mystified, I asked how she knew that that last bit belonged with the other fragments on the paper.

"Different notes burn differently," she explained. "Paper burns differently."

"But the paper's all the same, isn't it?"

"Originally, yes; but the char of a crumpled note is different from that of a note that's still smooth. Age affects it, too. A note that's been handled a lot will be greasy, from the fingers, you see. The char won't be the same as the char of a new note. Then, when a note has been folded lengthwise, sometimes we can see the crease. That helps, because the creases are never exactly in the same place. And some people, especially women, fold the notes up into an oblong about the size of a calling card, so they will fit in a change purse. Face powder, lipstick, perfume—these are but a few of the very many things that have an ef- *(Continued on page 209)*

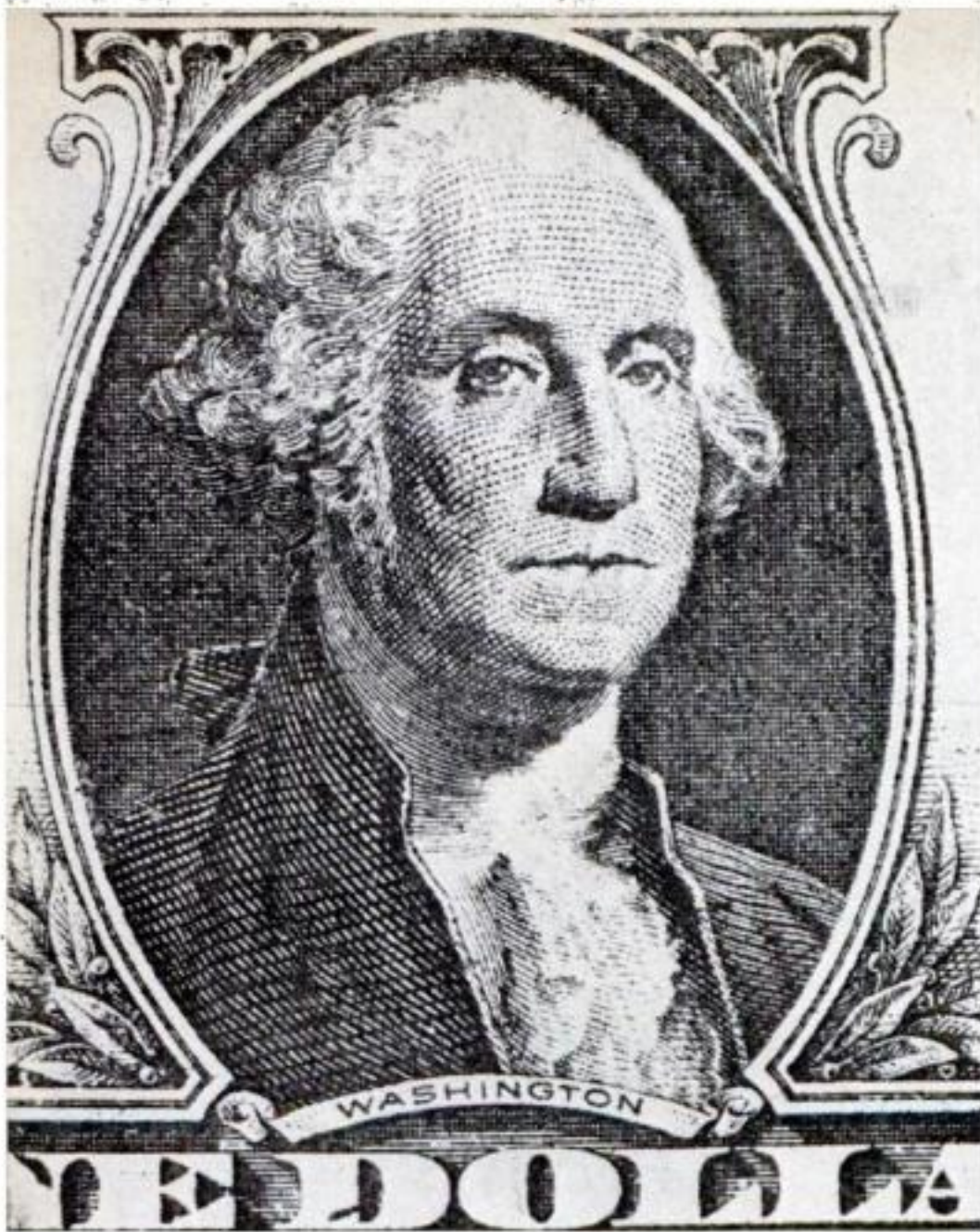


This is from a good dollar bill. The outstanding feature of our notes is the masterly engraving of the portraits, of which there is a different one for each denomination; so it's easy to spot raised notes

On the section of the good note below is indicated the security afforded by hand-engraved lettering. The serial number and the Treasury seal are on a separate plate and are printed in a different color



SERIES 1935 A



Here is a counterfeit, deceptive until you compare the nose, eyes, mouth, and hair. Notice the background, too; the irregularities show up in comparison with the precise cross-section lines in the genuine

In this and other counterfeits, notice that the serial number is almost always unevenly spaced, poorly aligned, and jagged-edged. Also note that the points around the counterfeit seal are irregular and blobby



SERIES 1935 A



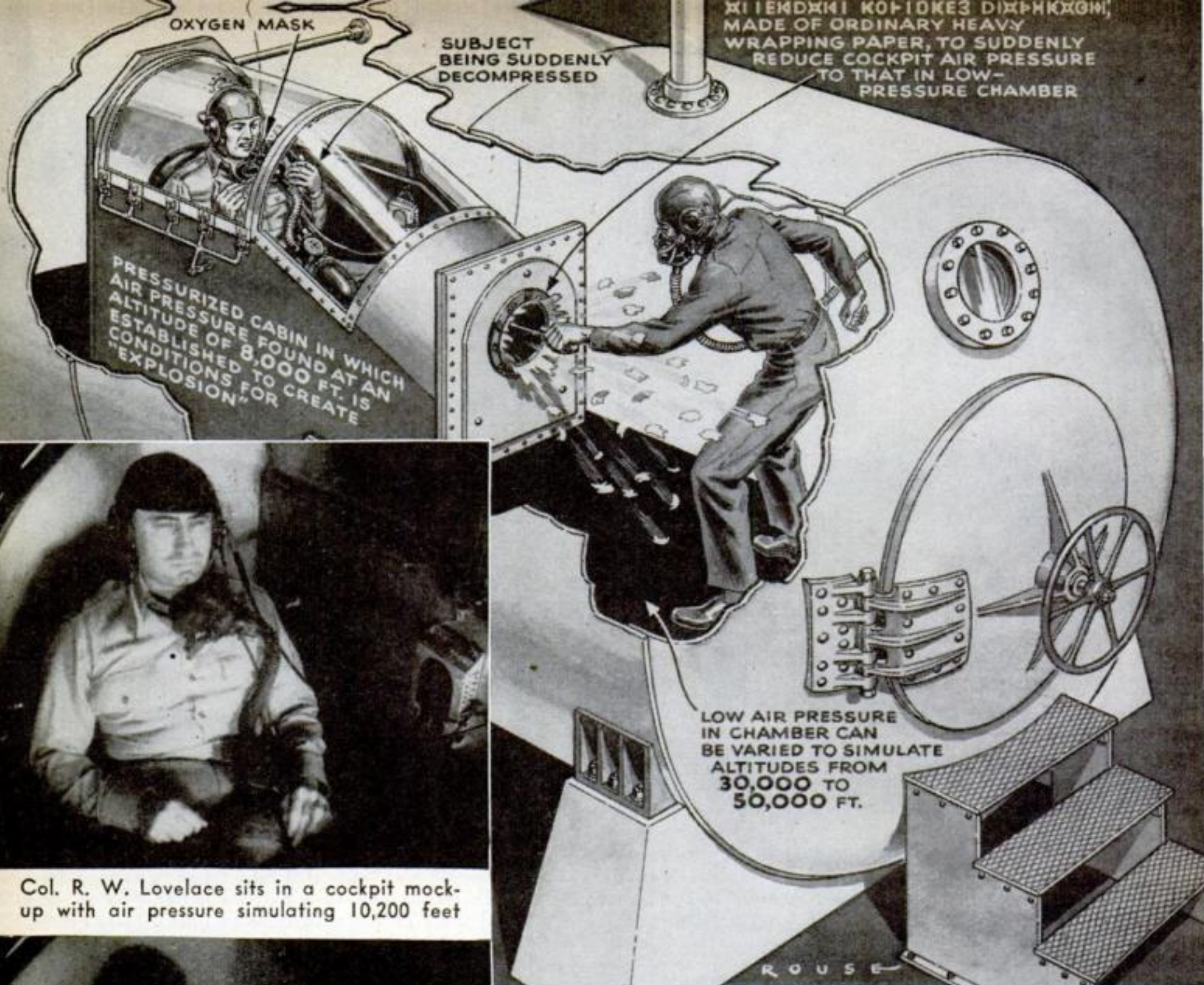
Keep your eyes open for this phony dollar—serial number K70025356A, if it hasn't been changed by now. Check letter and face-plate number (below SERIES 1935) are K1372. Background of portrait was brushed in

Would you be fooled by such an obvious counterfeit as this one? Probably not, but it has taken in a lot of otherwise careful people who have failed to examine their money. Note its number, and watch for it



WA

D.C.



Col. R. W. Lovelace sits in a cockpit mock-up with air pressure simulating 10,200 feet

In this "explosive decompressibility chamber" at Wright Field, men go from 8,000 to 35,000 feet in a split second

WHAT HAPPENS TO FLYERS WHEN PRESSURIZED CABINS "EXPLODE"

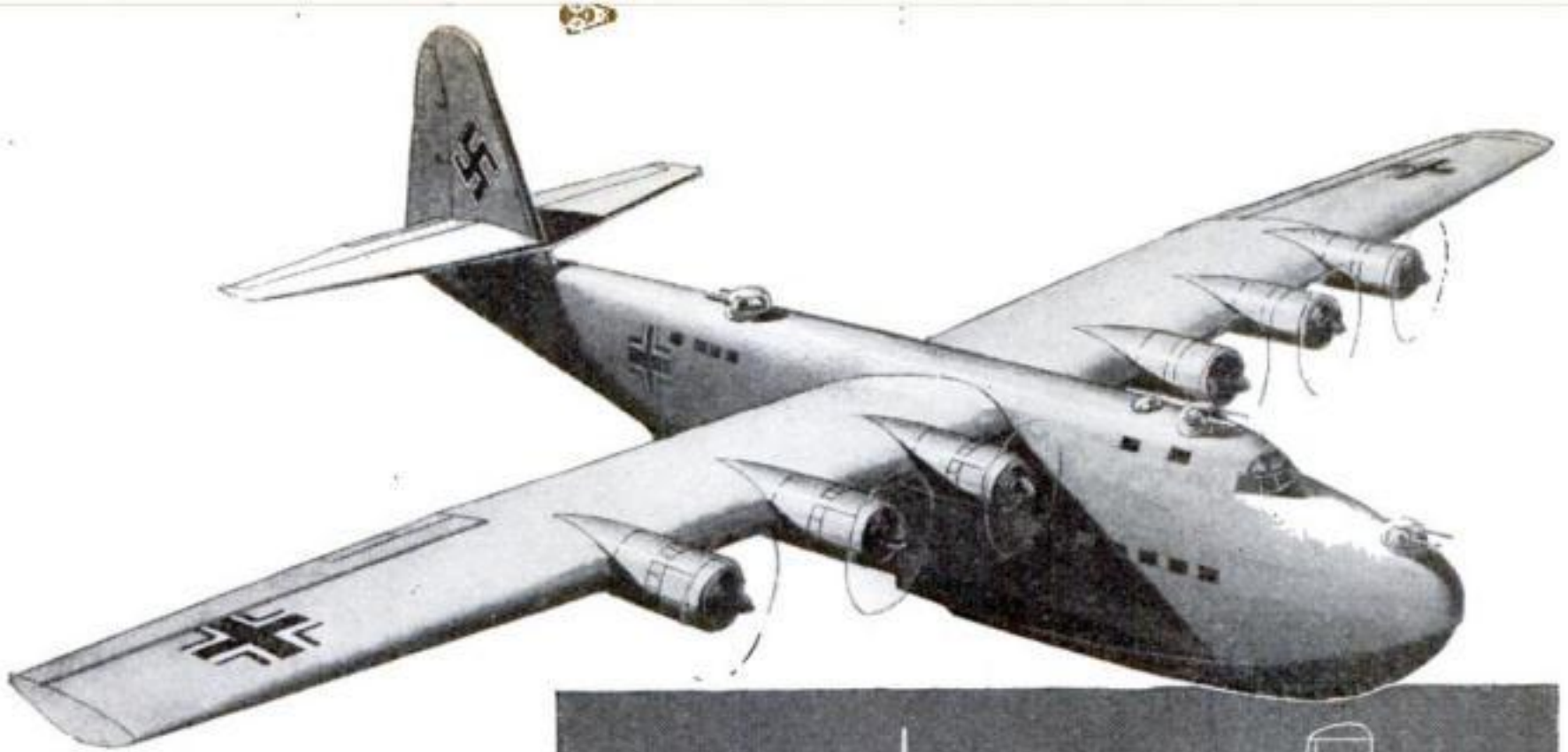
FOR a long time, men wondered what would happen to them if they were flying along at considerable altitude in a plane equipped with a supercharged cabin or cockpit and suddenly the pressurized compartment got a hole in it.

To put it another way, what would happen if flak or airplane-cannon fire carved chunks out of a supercharged fuselage in a fighter plane or a bomber at 40,000 or even 50,000 feet?

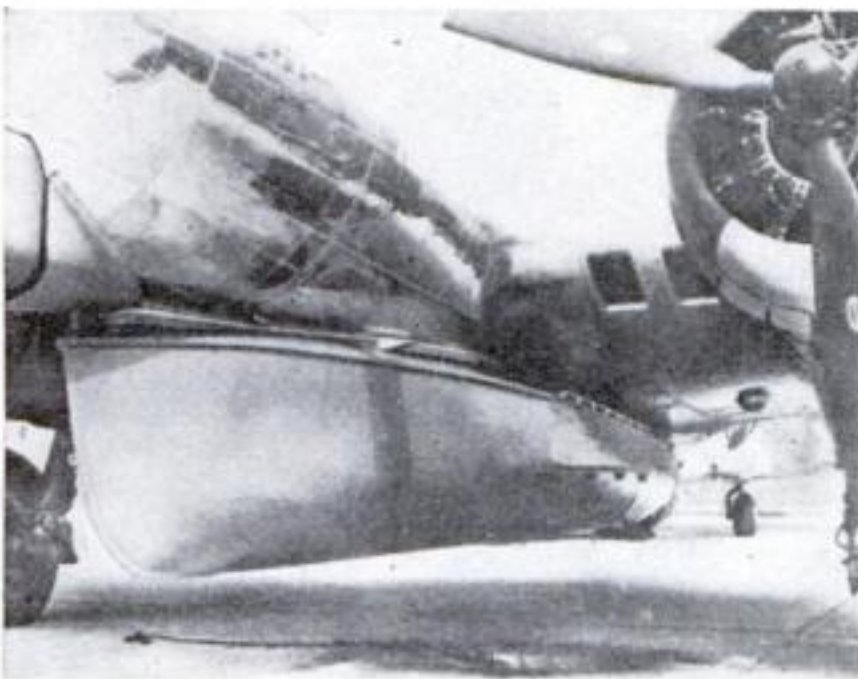
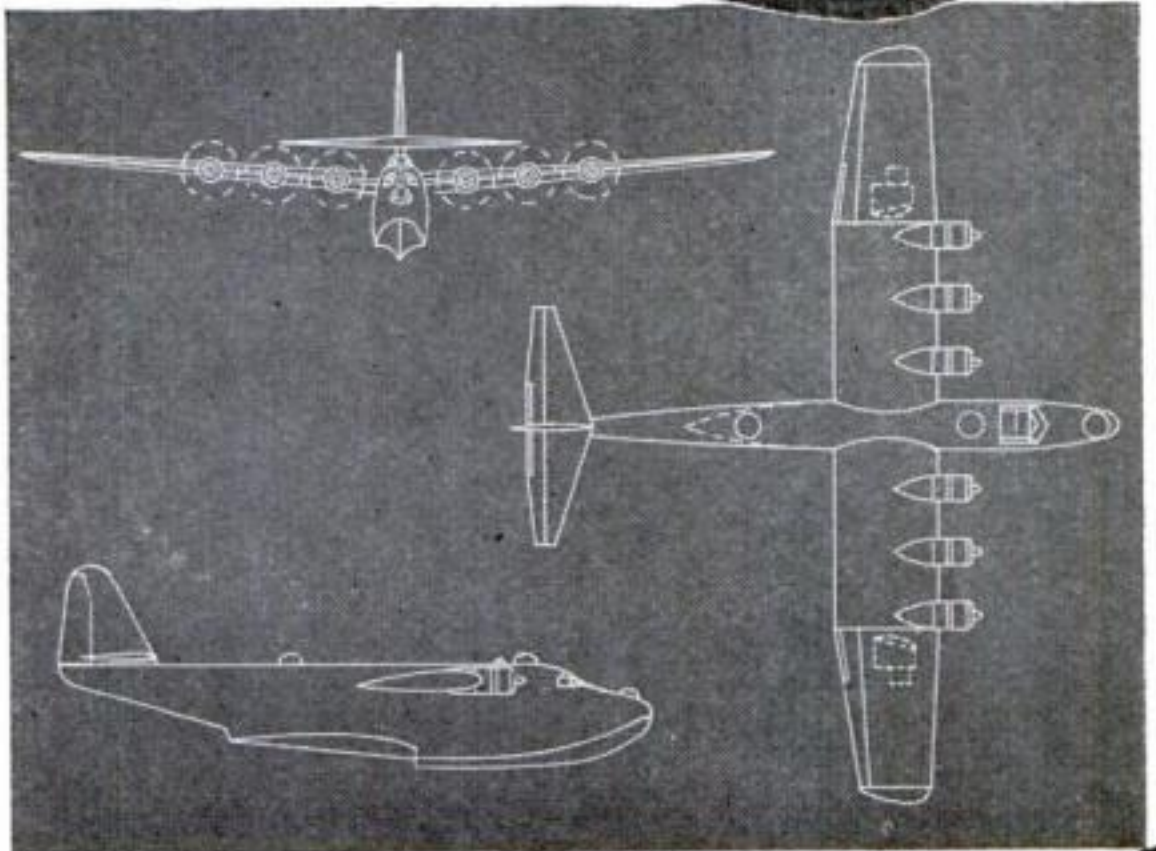
A good many fanciful ideas cropped up: It would be like popping a paper bag filled with air with your fist. The gush of air would assume gale proportions. Fearful things would happen to the body. If the stomach contained gas, its outrush would tear away the esophagus. Air seeking release from the lungs would maim the tissue. Gases in the abdomen literally might explode.

Nothing like that happens. (*Continued on page 206*)

POPULAR SCIENCE

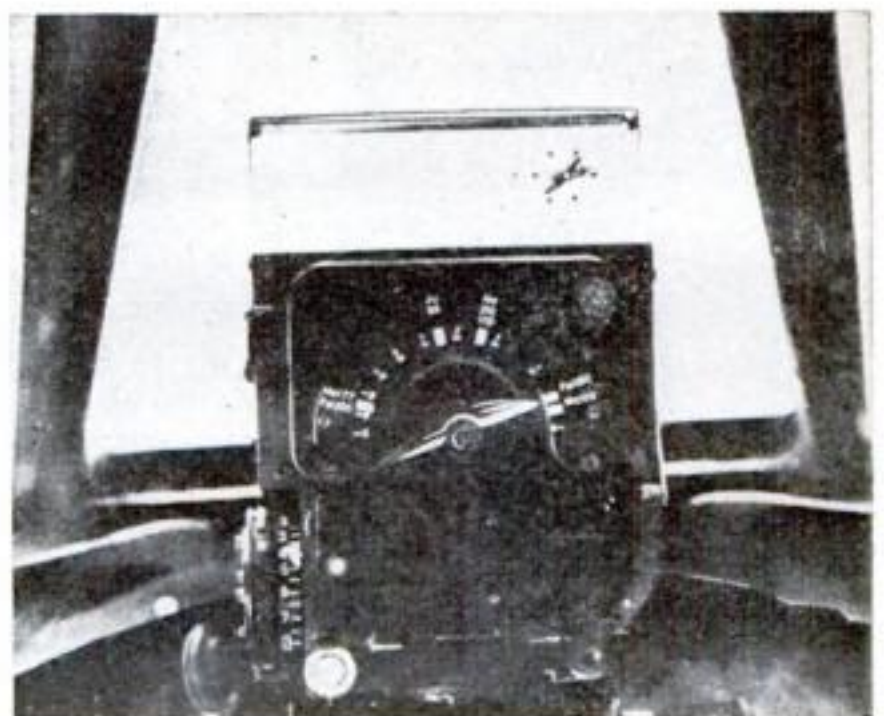


SIX-ENGINED NAZI BV-222 flying boat, originally designed for transatlantic passenger service, has been converted into a long-range patrol bomber, although little has been heard of it. Authorities thought it might have been converted into a military plane for bombing our east coast. It has a span of 150 feet, is 112 feet long, and weighs 100,000 pounds with maximum load. Its speed was around 200 m.p.h. In conversion, nose and tail turrets were added to handle twin machine guns.



PLANE CARRIES BOAT. Reversing the role of the aircraft carrier, this Boeing B-17 Flying Fortress takes a 27-foot lifeboat aloft. Fitting snugly against the underside of the big bomber's fuselage, the "Flying Dutchman" is ready to be dropped by parachute to flyers or sailors marooned on an island or adrift on the sea. It contains food and equipment sufficient to enable the distressed mariners to make a 1,500-mile voyage, if necessary, to reach land or be rescued.

THE RATIO OF KILLS to combats has nearly doubled since the introduction of British gyro gun sight into fighter planes, few months ago. It consists of a number of electrical units that supply information to a sighting head in front of the pilot, who sees the enemy aircraft on a glass screen $4\frac{3}{4}$ by $21\frac{1}{2}$ inches (see below). The sight automatically makes all deflection allowances that may be required to register hits at 400 miles an hour.



What's New in Modern Living



PLYWOOD AND GLUE are used in this library cart built without nails by I. F. Laucks, Inc., of Seattle. The cart may be employed also as a stationary bookshelf.

AUTOMATIC DISHWASHING is done in a new sink accessory without a motor, belts, or a whirling spray arm, operation being simply on city water pressure. The machine is a product of Q. E. D. Dishwasher Co., of Alhambra, Calif.

SHOPPING LISTS and household reminders are jotted conveniently on a wall memorandum pad equipped with paper in a continuous roll that can be torn off in any length required. The metal frame, finished in blue, white, red, or green, also contains a bracket for holding a pencil. Extra paper is available. The New York distributor is Lewis & Conger.



PICKING UP dropped articles or the daily paper is possible without stooping for anyone who uses this cane. It has a pick-up finger controlled at the handle. W. H. Mason, of Leesburg, Ohio, is the maker.

WHEN BOTH HANDS are occupied, a phone may be held for use, as shown at the right, by a heart-shaped shoulder bracket made of wool felt and attached to the receiver. Hold-the-Phone Company, of Dayton, Ohio, manufactures the device.





U.S. Army photo

Sturdy white leather camouflages troops in arctic regions

LEATHER IS TANNED WHITE throughout with a new mineral tanning agent perfected by Rohm & Haas—a basic zirconium sulphate named Zircotan, which produces a cream-white rather than a blue-white color. This remains fast with cleaning. The leather is used in a variety of articles.



A PNEUMATIC CHAIR made of flexible plastic in a ring-like design, as shown above, is said to seat a person as comfortably as an upholstered spring chair. It is supported on a folding frame and, when deflated, can be packed easily in a brief case along with its base. Both the idea and design were developed by William Miller, of the Gallowhur Chemical Corp., New York.

BUILT-IN MITTENS on the sleeves of a coat have been designed by Mrs. Gerda Rasmussen, of Oceanside, L. I., principally to forestall the losing of mittens by her small son. Each mitten is made in two halves, being joined by a slide fastener that is pulled shut all around the hand, as shown below, and locks at the wrist. The mittens can be turned up as cuffs when not worn.





He had silver eagles on his shoulders, crossed sabers on his lapel.

Gus fixes up a retread

By MARTIN BUNN

THE big limousine that drove into the Model Garage driveway was a good make and almost as old as it was good. As Gus Wilson slid open the shop door in response to repeated honkings of its horn, a brisk little Army sergeant hopped from the driver's seat. Gus noted that the hash stripes extended almost up to his elbow and that his legs had a bow not acquired in automobiles.

An officer stepped out as the sergeant opened the door of the tonneau and stood at stiff attention. He had silver eagles on his shoulders, crossed sabers on his lapel, and a mustache that verged on the handlebar style and was startlingly white on a weather-beaten face. His complexion reminded Gus of the rich color that years of use, saddle soap, and care give good leather.

"Colonel Hawkesbury!" boomed the little sergeant in a big voice.

"Good morning, Colonel," Gus said.

"Mornin'," Colonel Hawkesbury replied with surprising mildness. "We've been havin' so much trouble I thought we'd better get some expert assistance—both Sergeant Brady and I bein' pretty much on the

amateur side when it comes to automotive equipment."

Sergeant Brady's red face turned purple, and he muttered something under his breath. The Colonel fixed him with a cold, gray eye. "What was that, Sergeant?" he demanded.

"I didn't say anything, sir!" Sergeant Brady snapped.

"Oh—I thought you did," the Colonel said. He looked at Gus and winked. "The Sergeant's a good man with horses, but he soon gets beyond his depth when he has to deal with transmissions. I have completed an Army course in motor mechanics, but—what's that, Sergeant?"

Sergeant Brady had emitted an involuntary choking sound. He cleared his throat. "Nothing, sir. I just coughed, sir."

"Oh, you just coughed," the Colonel repeated, and turned back to Gus. "As I was sayin' when the Sergeant coughed, I have completed an Army course in motor mechanics, but my practical experience has been limited. The Sergeant and I are changing stations, and are en route from Texas to Boston. We got along well enough until yesterday afternoon when the car began to behave in a most uncomfortable manner . . . Just what were the symptoms, Sergeant?"

"Engine began to skip, sir," Sergeant Brady said. "After I'd slow down in traffic, the car would rush ahead in spurts no matter what I did with the accelerator. Pretty near ran us into a truck, sir."

"Yes—it was most uncomfortable and embarrassin'," Colonel Hawkesbury agreed. "The Sergeant suspected the fuel pump. What did you do with it, Sergeant?"

"Took the fuel pump off and disassembled it, sir," Sergeant Brady said. "Cleaned it thoroughly. When I put it back on, the engine ran better. Once we got out on the road we did 35 as smooth as you please. But when we hit the next city it was the same old story—miss and jolt whenever I had to slow down below 20. Then half the time I couldn't speed up again. Sometimes even, all that stamping the accelerator pedal down to the floor boards did was to make the engine skip and jolt worse—it would start to race and all of a sudden go dead. Never had a car act like that before."

"My own diagnosis was that it was the distributor," Colonel Hawkesbury put in. "But, so far as is possible, I refrain from interferin' with an NCO who is in charge of a job, so I told him to do what he thought best. What then, Sergeant?"

"Well," said Sergeant Brady, "when I had disassembled and put back the fuel pump, the engine idled as smooth as anyone could ask. But as soon as we hit traffic it began to act up again. That made me think that mebbe it was the carburetor, sir."

Colonel Hawkesbury snorted. "Carburetor! We bucked and jolted into a town, and you worked on the carburetor all evening."

Sergeant Brady looked straight ahead and spoke briefly. "I examined it, sir. Took off the air cleaner. Checked and cleaned the float chamber and all parts. Blew the carburetor out with compressed air. Reinstalled it. Cleaned and checked all spark plugs—got a strong spark at each. Started the engine. There was a nice stream of gas flowing into the float chamber, and it idled smoothly. Road-tested the car. Same trouble as before, sir."

The Colonel gave Gus another wink. "Well, what did you do then?" he demanded.

Sergeant Brady looked injured. "One-thirty by then, sir. I went to bed."

"First sensible thing you'd done all day!" Colonel Hawkesbury said. "You never looked at the distributor, of course." He turned to Gus. "The Sergeant will tell you the rest of the story, and I hope you'll be able to find what's wrong. I must put in a long-distance call. May I use your phone?"

Gus took him into the office. "Thanks," the Colonel told him. "By the way—I wouldn't pay too much attention to what Sergeant Brady *thinks* the trouble is. He used to be the best stable sergeant in the Army, but since they've mechanized the cavalry he hasn't been able to keep up. No mechanical ability—none at all!"

Gus left the Colonel calling his number and went back into the shop. An astonishing change had come over Sergeant Brady. He had pushed his overseas cap far back on his head, disclosing a bald dome fringed by ginger-colored hair that was beginning to go gray, and he had a cigarette hanging from the corner of his mouth.

"What's the old buzzard doing?" he asked. "Phoning? Good. Once he starts shooting the breeze he's good for 15 minutes. I've got to have a smoke—he's been riding me so hard I got butterflies crawling all over me. He used to be the best cavalry officer in the Army when they had hosses, but what he don't know about cars would fill a shelf of technical manuals."

Gus raised the hood of the venerable limousine. "I should think it would be pretty hard for an officer who doesn't know anything about automotive equipment to command a regiment these days," he remarked.

Sergeant Brady grinned, but his face wasn't happy. "The Colonel ain't commanding a regiment these days," he said grimly. "He's commanding an office full of Wacs—and I have to sit out there with them and listen to their talk about their dates. Me and the Colonel—we're just retreads."

"Huh?" Gus asked.

"Retreads," the Sergeant repeated. "Injun fighters, if you like that any better. Guys who have been on the retired list and have got back in for the war. The Colonel retired 10 years ago, and I went with him—I've been with him, one way or another, most of the time since he was a second looney fresh out of the Point."

"The Colonel's a fighter—he didn't get all those ribbons for sitting around GHQ looking wise—and he says we've got to get back in the Army. I told him we'd get put on some desk job, but he says he knows a way

"A State cop comes up and tells us you're a motor wizard"



to beat that—he'll get us sent to a motor-mechanics school, and after that we'll get back in the cavalry. He gets us sent to the motors school, all right. Of course he don't learn anything at it—no head for machinery. And then they put us on a desk job, just like I'd told him they would."

"I see," Gus said. "Well, now, about your car—"

"There's something the matter with the carburetor," Sergeant Brady offered. "Or maybe the clutch is slipping. Must be one or the other—can't be anything else because I've checked everything. When we started out this morning, I had to toe the clutch in and out to give the engine a chance to get up some revs."

"We went along that way for miles. Then we had to stop because the Colonel said he smelled something burning. While I had my head under the hood, a State cop comes along on a motorcycle and wants to know what's the matter. Then he tells us you're a motor wizard and that your place is only a couple of miles up the road. So we make it here."

"Say," the sergeant continued earnestly, "don't pay any attention to what the Colonel says about the distributor. He don't know anything about distributors—and before we started on this trip I—" He stopped abruptly.

Gus looked up. Colonel Hawkesbury was coming through the office doorway. Sergeant Brady had undergone another quick transformation. His cigarette had vanished, his cap was at just the correct angle, his red face had lost all expression.

"Found the difficulty?" asked the Colonel.

"Not yet—but it won't be long," Gus said confidently. "I'll have to do a little checking."

Gus Wilson never seems to hurry, but he works fast. He went over the gasoline line from tank to carburetor without finding anything wrong. "Nothing the matter with the carburetor," he said.

"I told the sergeant that yesterday," Colonel Hawkesbury said triumphantly.

Gus got into the car and started the engine. It took off well enough and ran

smoothly at idling speed, but when he pressed his foot on the accelerator it began to miss badly. He turned the ignition key and got out.

"Try the distributor," said the Colonel.

"I'm going to," Gus told him. "From the way your engine runs, I'd say there's something wrong with the ignition." He took off the distributor cap and examined the points. They were badly burned and pitted from excessive arcing. "Yes," he said, "the trouble is in the ignition—and my guess is that it is caused by the condenser."

The Colonel looked at the Sergeant, and the Sergeant stared straight ahead.

Gus smothered a grin as he reached behind the massive old distributor to where the condenser was grounded to its housing by a screw.

"Here's the cause of your trouble," Gus reported. "Whoever installed that distributor forgot to tighten the condenser grounding screw. After a good many miles of driving, vibration—or maybe rough roads—shook the condenser loose, with the result that the arcing of the high-tension current across the distributor points made your ignition go haywire. You'll need new points and—to be on the safe side—a new condenser."

Sergeant Brady looked at Colonel Hawkesbury, and Gus saw that his blue eyes were blazing. The Colonel's face was red under its mahogany hue. "Do whatever is necessary, please," he told Gus.

Gus installed a new condenser and points, and the Colonel handed him a bill. When he came back from the office with the change, Colonel Hawkesbury and the sergeant were already in the car. Their faces were flushed, and they were quarreling.

"Sergeant," the Colonel snapped, "I told you yesterday it was the distributor. If you hadn't been so bull-headed—"

"It was your fault, sir!" Sergeant Brady interrupted. "I caught you fooling with that distributor the day before we started this trip. When you give a man a job to do, sir, it's only fair to let him do it without interference—"

"I've already told you I'm sorry, Sergeant," the Colonel said. "From now on, do what you please with the car. I'll never touch it again. Now, if it were a horse—"

Sergeant Brady grinned widely over his shoulder. "If it was a horse, sir," he said, "we'd both know a lot more about it!"

The old limousine rolled out of the shop, its engine purring.

Gus was still chuckling when his partner Joe Clark came in and asked, "What you been doing, Gus?"

"Oh," Gus said solemnly, "just a little job of fixing up a retread."

GUS SAYS:

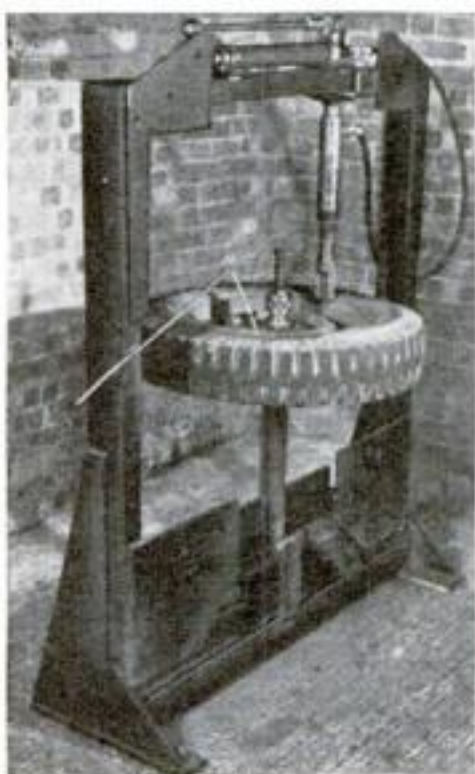
With cold weather due, remember that short runs which don't let the motor warm up increase condensation and oil dilution. If you must make short runs, change the oil often. Better still, don't start your engine unless you can let it get thoroughly warm.



AUTOMOBILE DESIGNER Delmar G. Roos, shown above with the first Willys jeep, which he engineered, is no newcomer to the field of Army personnel-carrier design. In 1917, he turned out six special Locomobile sedans

for General Pershing. These cars had double rear wheels and were equipped with six-cylinder, 120-hp. engines. Each was tested to 100 m.p.h., the speed required by Pershing before acceptance.

MAINTENANCE PROBLEMS in the Army, where unusual driving conditions—such as blackouts, narrow roads, unfamiliar terrain, and fog—combine to cause many accidents, challenge ingenious GI's to improvise tools that speed repairs. Typical is the wheel press shown at the left, the product of M/Sgt. Donald Guger. It is used to straight-



en wheels and consists of an iron frame, a shaft to hold the damaged wheel, a length of rod that is employed as a marker, and a portable power press. The wheel is spun on the shaft with the marker riding on the rim; uneven spots are noticed and marked; then each spot is brought under the press so corrective pressure may force the wheel back into alignment.



ELECTRICALLY DRIVEN, the midget vehicle shown above was built by John Bowker, left, of Melbourne, Australia, after three years of experimentation. With him in the picture is his brother Len. The little car has a top speed of 30 m.p.h. It recently ran continuously for 111 miles in a test of battery endurance. To recharge the batteries costs about 50 cents, and other operating expenses are said to be equally low.

LIQUIFIED PETROLEUM GASES, which remain liquid only as long as they are kept under pressure, and which expand and contract with temperature changes, are difficult to move. To overcome this difficulty,

the Heil Company has developed the special trailer shown below. The tank has a capacity of 4,000 gallons and will withstand a pressure of 250 pounds per square inch. Since it is underslung, its center of gravity is low. It is made of welded high-tensile steel of a gauge so light that the body weighs a ton less than does a conventional unit.





DOES YOUR CAR SHAKE LIKE *What You Can Do*



By TOM McCAHILL

ROUGH engine idling has caused as much perturbation and downright exasperation as almost any other automobile ailment. To a driver who has experienced it in only its mild forms, it may seem insignificant; but this frequently occurring trouble has turned many a hair gray on service managers' heads. Owners have been known to trade in their cars or sell them outright just because of this one annoyance. A car may perform beautifully on the highway or while climbing hills, but if it vibrates like a jitterbug while waiting for a green light, all pride in ownership soon disappears.

There are many causes of rough idling, some so simple they are often overlooked. One common remedy often resorted to is to increase the idling speed on the carburetor-throttle stop. This undoubtedly smooths out vibrations, but it is pretty hard on the ration book and is certainly not a real cure. In a recently conducted survey, it was found that more than 50 percent of automobiles tested at random idled at speeds ranging from 500 to 700 r.p.m. Compared with a normal idling speed of 400 to 500 r.p.m., this indicates a serious waste of gas, coupons, and money.

The most frequent cause of rough idling by an otherwise efficient engine is an over-rich mixture resulting from flooding of the carburetor at idling speeds. It is a fault that is often difficult to spot because the flooding is *internal* and the vacuum in the intake manifold absorbs the excess fuel before it can be seen. This type of flooding should not be confused with that customarily experienced when the choke is used too freely and which is readily apparent both from refusal of the fuel to burn because of lack of sufficient air and from the

noticeable smell of the overflowing gasoline.

Several things can cause internal carburetor flooding, but the most likely is the needle-valve and seat assembly in the float chamber. The needle valve and seat maintain a constant level of fuel in this reservoir when they are functioning properly. If they allow gas to continue its flow after the shut-off level has been reached, they should be inspected for defects. Sometimes even a small piece of dirt or a hair resting under the needle will keep it from closing as fully as required and thus prevent the proper halting of the flow at the shutoff point. If the car has been in use for a long time, the seat may be worn or the needle bruised. In a case of this kind, it is wisest to replace the unit with a new needle valve and seat.

Another thing to check in a flooding carburetor of this kind is the float, which may be leaking and thus failing to rise and close the needle valve. Such a leaking float is best replaced with a new one, though a satisfactory repair can sometimes be made

Perfect seating of the carburetor needle valve is essential. A speck of dirt or a hair may allow gas to continue to flow at the shutoff position



A CONCRETE MIXER WHEN YOU STOP AT A LIGHT?

About Rough Idling

by drilling a small hole through the crack or other leak, letting out the enclosed gas, and then lightly covering the hole and remaining crevice with solder. It's desirable, of course, to make as little a change in the weight of the float as possible.

A mixture that is too rich can also be caused by a too-high setting of the float. The high level floods the carburetor at idling speeds and causes the engine to roll and stall at what is considered a normal setting. Frequently the cause is a float hinge that has been bent during overhauling, or bad needle wear that permits the float to rise higher than it should before shutting off. A bent hinge can be bent back easily, but a float-level gauge should be used in making the final setting.

One contributor to flooding that is rarely checked is an overpressured fuel pump. This causes the needle to bounce back every time the pump pulsates, forcing additional fuel into the float chamber. The float assembly is gauged for a specific pressure, and when this pressure is passed the carburetor will flood. A usual cause is wear in the pump linkage. It allows the pump arm to develop a whip and build up undesirable pressure.

While examining the carburetor, don't overlook the idling jet. This unit may be partially or fully obstructed by foreign matter. If it is fully obstructed, no gasoline will pass through at all, and at speeds below the intermediate-jet range the engine will stall. A partly clogged jet has the same effect to a lesser degree, causing the engine to buck, roll, and come to a stop. Enriching the mixture through the idling

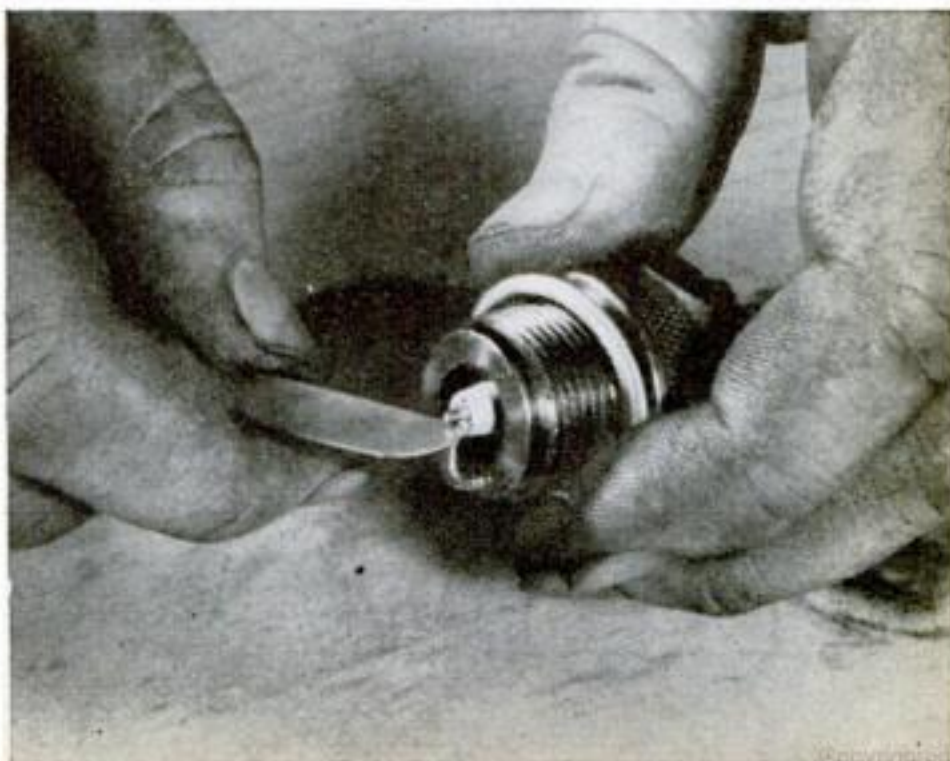
adjustment is only a partial remedy; the obstruction should be located and cleaned out.

Incorrect timing is another frequent cause of rough idling, and it may be the result of one of several conditions. The first step is to look at the locked timing position of the distributor body, which may have been set in advanced position through carelessness on the part of some mechanic. Slight inaccuracies in the timing are often overlooked in the effort to improve idling, since as a rule they affect road performance only a little. This slight difference, however, results in a lot of engine rolling, bucking, and stalling. Distributor points that are set too far apart may be responsible, for in such a case the points will break several degrees before the normal requirement and cause roughness, since the piston will still be on its way up when the explosion occurs. At fast speeds, the engine may appear to be running efficiently because the increased speed of the piston in relation to the time of the explosion will overcome some of this advance.

Incorrect spark-plug gaps are another cause of early advance, and spark-plug settings have ruined the reputation of many mechanics and service managers. You may have had the experience of installing a new set of spark plugs only to find that your engine ran better with the old ones. The new plugs were all right, but they were gapped too close for smooth idling. Most spark plugs come from the factory set at .025" or less. This gap works perfectly for some engines, but for others it causes roughness at low speeds. [Turn the page.]

In adjusting a float level that is too high and thus permits an overrich mixture, be sure to use a float-level gauge in making the final setting

On some cars, widening the spark-plug gaps from the normal .025" to .035" or .040" lets pistons "ride with the punch" while the engine is idling



Practically all engines will idle smoothly on a slightly retarded spark because then the piston will have reached top dead center or a little beyond when the explosion occurs. This situation may be compared to riding with a punch in boxing—the piston goes along smoothly instead of taking the full smash of the explosion—and this is an effect greatly to be desired in an idling engine. With increased speeds, the automatic spark advance will see to it that the spark is delivered in time to give the most effective wallop.

A wide gap (.035" to .040") in the plugs will retard the spark slightly at idling speeds because the potential must build up for an instant to gather enough power to jump the opening, while with a close gap

the spark leaps across without hesitation. The difference close gaps of .020" to .025" and wide gaps of .035" to .040" make in the performance of some engines is almost unbelievable. However, widening the gap will not work for all cars for the reason that some manufacturers have provided enough automatic spark advance to cover all ranges and speeds. When preparing to set the gaps on your car, it is best to consult your manufacturer's manual and follow its recommendation. And don't attempt to use a dime to gauge the adjustment; use a gap gauge.

Valve-tappet clearances that are set too close are also often the cause of bumpy idling. This condition is most frequently found in engines of the overhead-valve type. The reason for this is that an overhead-valve engine lends itself more readily to tappet noises, and to eliminate them mechanics too often set the valve clearances closer than the manufacturer intended. As a result there are lumps and bumps in the engine performance, and the cure may be found to be far worse than the original fault. In an overhead-valve engine, tappet noises can be eliminated in most cases and the proper clearance can still be retained if care is exercised. In cases where this cannot be done, it is far better to have a little noise that means nothing than to have a rough engine.

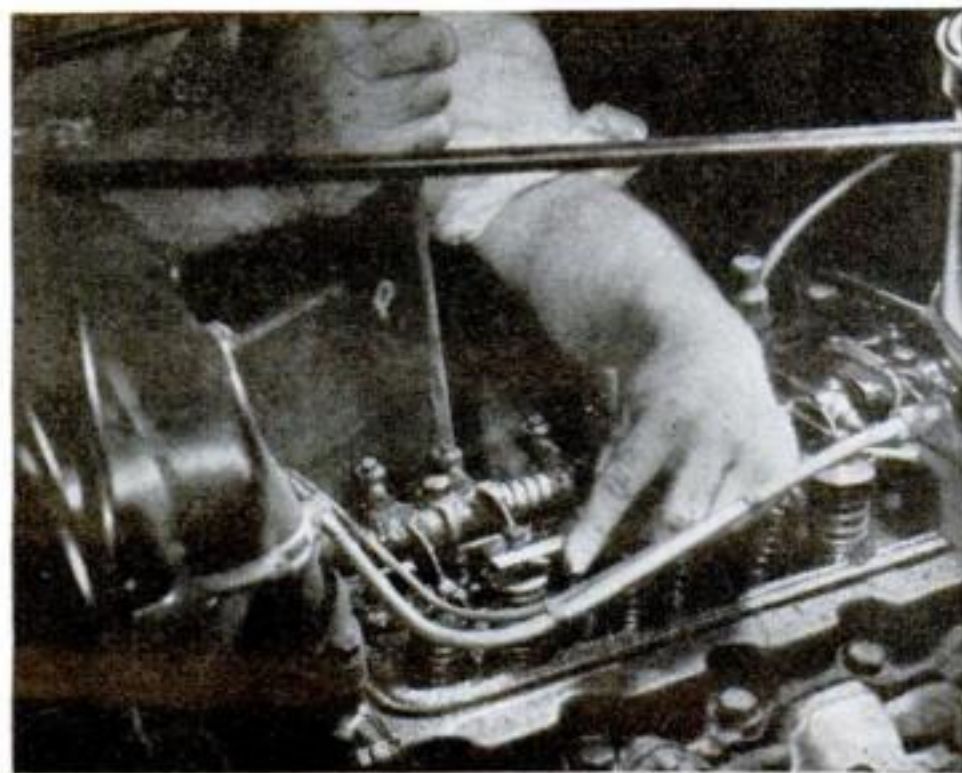
There are a number of other conditions that cause or contribute to rough idling, but they will be encountered rarely. A leaking intake manifold, for instance, can cause an engine to cut up surprisingly when it is running at slow speeds. Another villain—also fortunately rare, for it would be easy to overlook—is a faulty radio suppressor. A high-tension leak in the suppressor wiring can cause havoc. So can a leak in a vacuum-type spark control. Warped valves will very often function satisfactorily at comparatively high speed, though they may stick and cause roughness when the engine is idling. Faulty compression also will cause unevenness, and so will an automatic spark governor if it sometimes sticks.

But these are rare conditions. The chances are that if your engine is a rough idler you will find the cause and cure among those detailed in the preceding paragraphs. It will be good practice therefore to look first to the carburetion of the offending car, then to the timing at the distributor and spark plugs, and next to the valve settings before you start hunting for more or less obscure causes.

Distributor points set too far apart will open while the piston is still on the upstroke. This may not be noticed at fast speeds, but it will make idling rough



Decreasing valve-tappet clearance, sometimes resorted to by mechanics to eliminate valve noises, is a cure far worse than the fault—it puts bumps in the engine



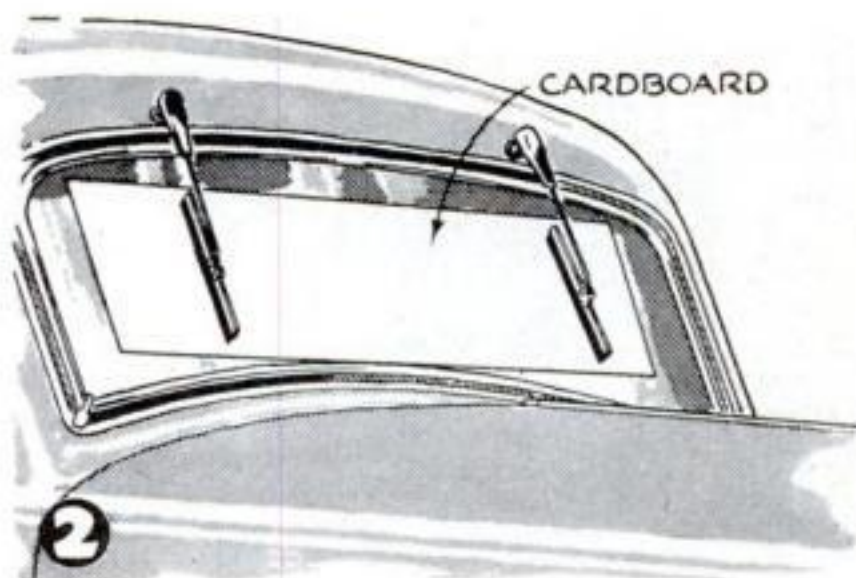
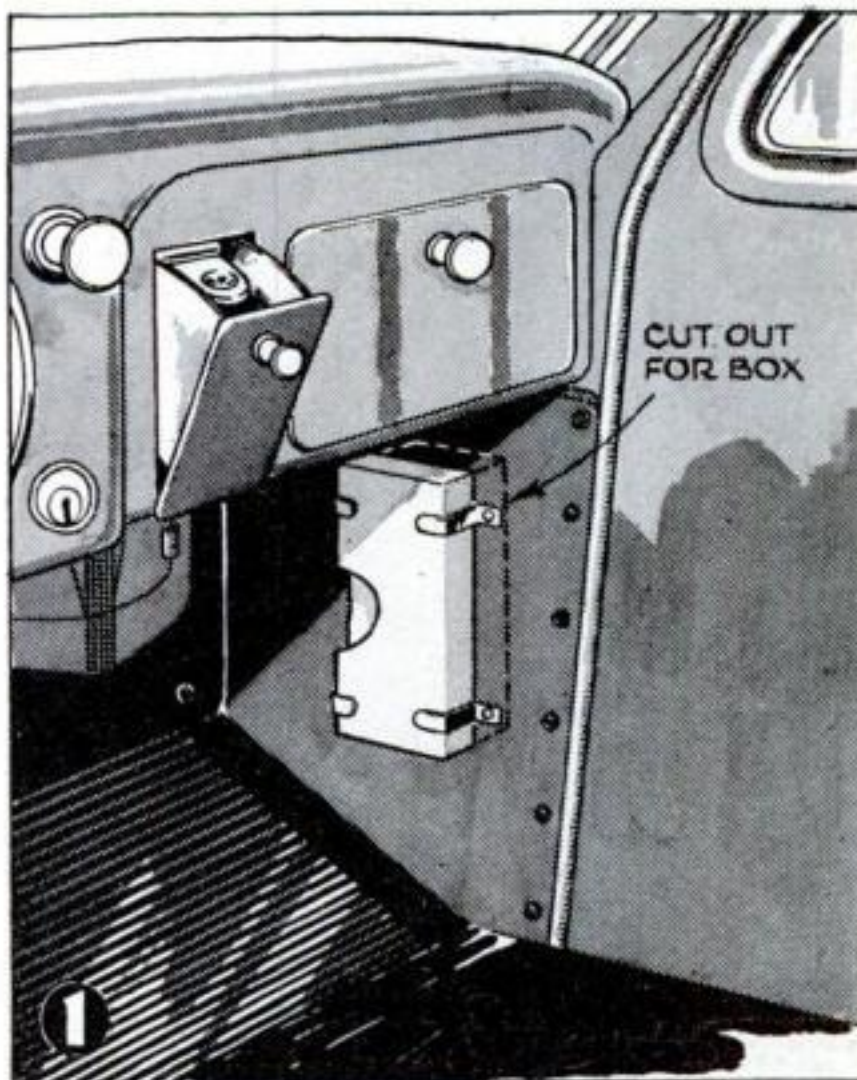
USEFUL AUTO HINTS

1 DISPOSABLE TISSUES are always handy to keep in a car for removing grease from the hands, cleaning the windshield, and similar purposes. Instead of cluttering the glove compartment with the box, cut a rectangular hole in the fiber paneling and secure the box in place with metal clips. If you do not cut the paneling, an extra clip is of course needed under the box.—S. J. D.

2 FROST AND SNOW on the windshield are a constant nuisance if you have to keep your car outside overnight in the winter. To avoid the bother of having to clean off the glass each morning, put a sheet of cardboard under the wiper blade when you park the car. Use separate sheets on a car having a divided windshield. It's much simpler to pull off the cardboard than to scrape away frozen snow and sleet.—J. J. B.

3 CLEANING CAR WINDOWS without lint or streaks is easy if you unhook the blade from the windshield-wiper arm and use it as a squeegee to remove the excess water. Most wiper blades can be readily disconnected without tools. One advantage of this method is that you always know where you can find the squeegee.—W. E. B.

4 LOCATING A LEAK in a gas line, a manifold-vacuum line, or other metal or rubber tubing is sometimes difficult to do visually or by the sound of air hissing out. However, if you block one end and blow a puff of tobacco smoke into the other, it's simple to spot where the trouble lies.—H. W. S.



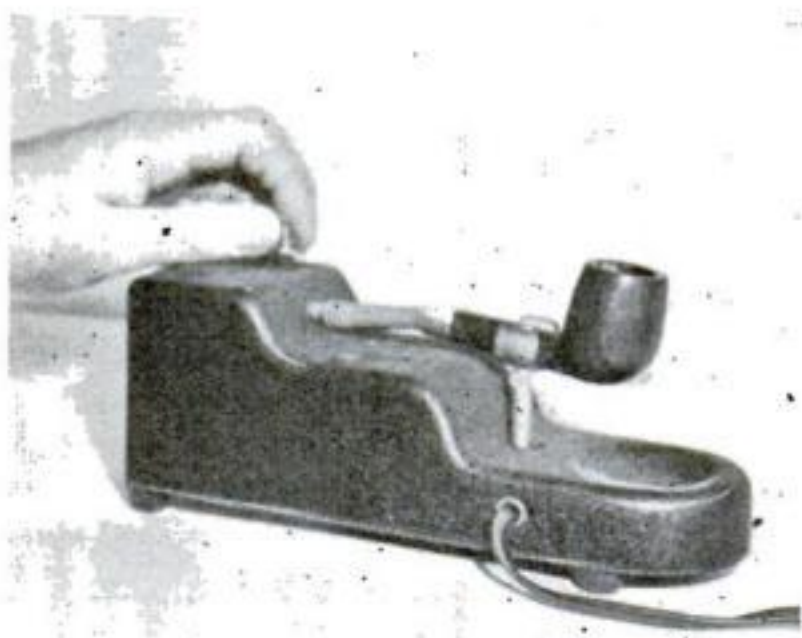
Drawings by
William Patrick

ON THE GADGET FRONT

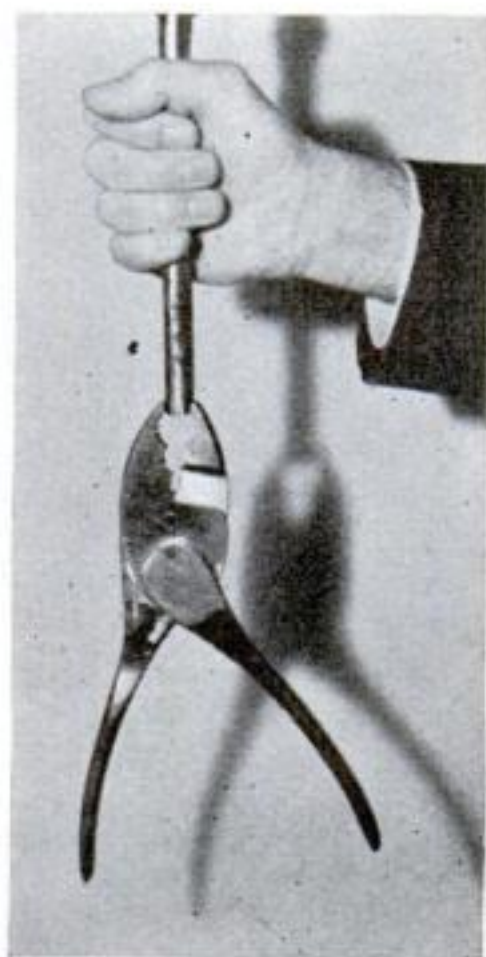


THE Crosby Research Foundation maintained by the famous Bing and his brother Larry (see P.S.M., Dec. '43, p. 85) has developed the gadgets below for commercial production. Some are made of noncritical material and will reach store counters soon; others are made of metal and cannot now be manufactured in quantity, but will be distributed as soon as restrictions on critical materials are eased.

THESE SUNGLASSES, unlike most, have no dark lenses. Instead, translucent shades are used to diffuse light from above. Thus the frames may be used for regular lenses, if the wearer requires them, or may be left empty, if one has perfect or good eyesight



ANY PIPE SMOKER will like the device that is shown at the left. It consists of an electric motor and bellows, and is used for breaking in pipes and cleaning them. By adjusting a knob, the machine can be made to alternately blow and suck, for breaking in, or to suck steadily, for cleaning. During the latter operation a chemical is put in the pipe to loosen the cake, and the sludge is sucked into a pad

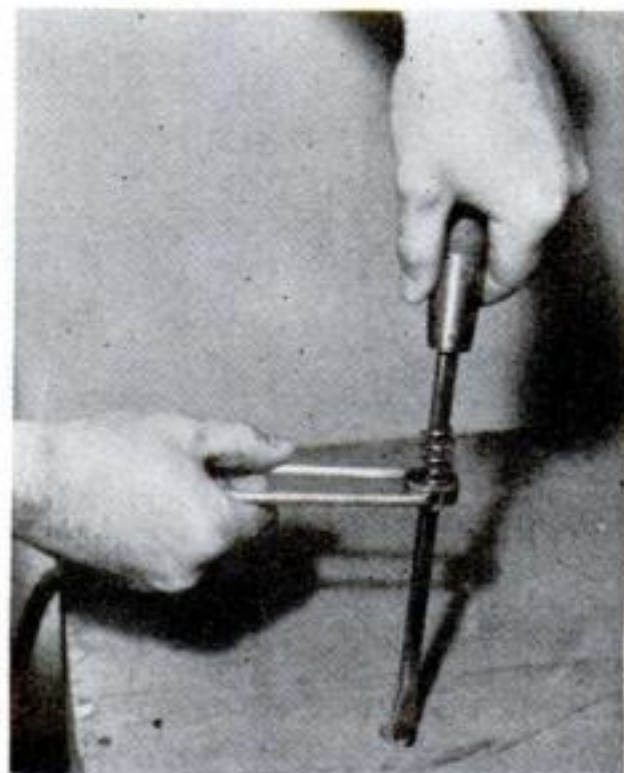


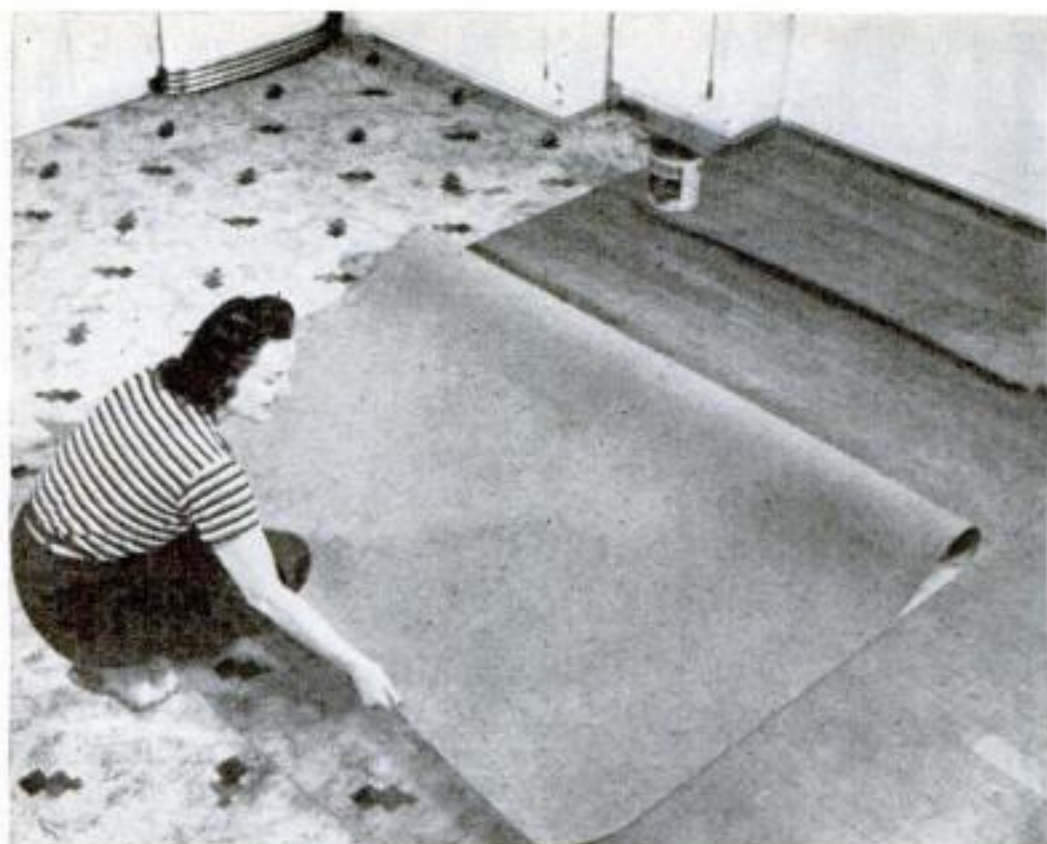
SELF-LOCKING PLIERS that have compound action and grip firmly, even when no pressure is applied to the handles, are shown in use above. They are handy for tightening small nuts



SOAP IS CONSERVED if rested on edge in this portable wall bracket. It is made of plastic and is firmly held, by means of a suction cup, to any smooth surface. The uptilted soap drains and dries speedily because there is no water-trapping dish beneath it

FOR STUBBORN SCREWS, a ratchet device has been attached to a screwdriver, as shown at the right. It is used to increase leverage and is fabricated from cold-rolled spring steel. When not in use, it folds up alongside the handle





PLASTIC-IMPREGNATED LINOLEUM that the home owner can readily lay without help is self-sealed against dirt. Cleaning is a matter of wiping regularly with a damp cloth, mopping occasionally with warm water and mild soap, and every three months applying liquid self-polishing wax. An instruction booklet put out by the manufacturer, The Paraffine Companies, Inc., of San Francisco, is good to obtain if you plan to do the laying yourself. It gives such detailed information as making a paste spreader from a 5" by 12" scrap of the linoleum itself.

FOAM PLASTIC, lighter in weight and lower in heat conductivity than rock wool, glass, and cork, has been developed by General Electric Co. at its plastics laboratory at Pittsfield, Mass., for a secret war use. It holds promise of many peacetime applications, especially in the field of home and commercial insulation. A 2½" by 9½" by 13" block weighs ¾ lb.

Interesting points in its manufacture are



NEW HOSE NOZZLES with a spray control that permits full water flow at any adjustment from fine spray to direct stream have a complete range in just a quarter turn without back pressure to strain the hose. They are made of rustproof, crackproof, and chip-proof acetate by the Plastic Die and Tool Corp., of Los Angeles.



illustrated in the laboratory photos below. A mixture of phenol resin is poured into a beaker (Fig. 1), generates its own heat, and begins to rise in two minutes, as in Fig. 2. Rising at the rate of 1" a second, the column is supported, as in Fig. 3, so it will remain erect. In Fig. 4, the column has reached its full height, and in a few seconds it will have cooled and hardened and the support can be removed.



MODEL BARRAGE

Exciting Fun Is Yours with This

By VERNON B. CASE

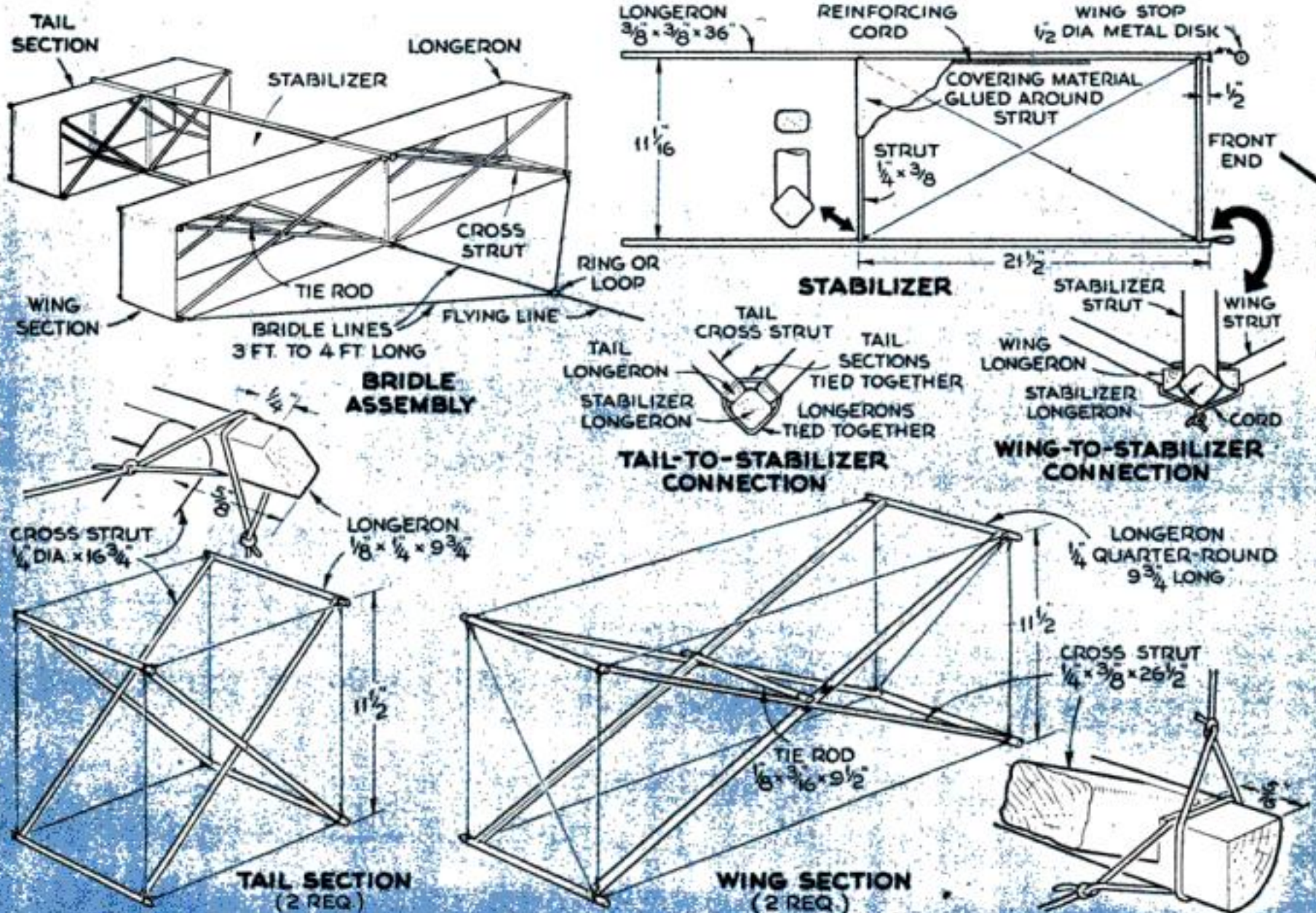
SHIPS traveling in areas that are subject to enemy air attack often use barrage kites to carry steel cables into the sky. The cables entangle any dive bomber that ventures too close. (See P.S.M., Aug. '44, p. 125.) A full-size kite would be too much for the amateur to build and handle; but here is a model with a four-foot wing spread that has enough lift to provide thrills aplenty.

The frame—that is, the struts, longerons, and tie rods—is made of white pine. The covering material is tissue paper or thin muslin (organdy).

Each wing section consists of four cross struts, four longerons, and one tie rod. Mark the mid-points of these struts and fasten

them together in pairs, using small nails and bending the ends over as shown in Fig. 1. Spread these pairs slightly to form X's and fasten the longerons to the notched ends with glue and small nails, as indicated in Fig. 2. An excellent adhesive for this purpose is model-airplane cement, or any similar quick-drying preparation, but you can use casein glue if you allow sufficient time for it to dry. Secure the tie rods in place with cord seizing or heavy rubber bands.

Next make the looped-end cords that hold the struts rigidly in position. Each wing section requires four horizontal, four vertical, and two diagonal lines. Use a light, strong cord. Brown waxed store string is too weak. Lightweight chalk line is acceptable, but 12 to 16-lb. fishing line is ideal. To make all the vertical lines uniform in length, use a jig consisting of two finishing nails and a board. Drive the two nails into the board so they are $11\frac{1}{2}$ " apart. Tie a bowline in one end of a piece of cord, leaving a loop about 1" long. Slip this loop over one nail.



KITE IS LIVELY FLIER

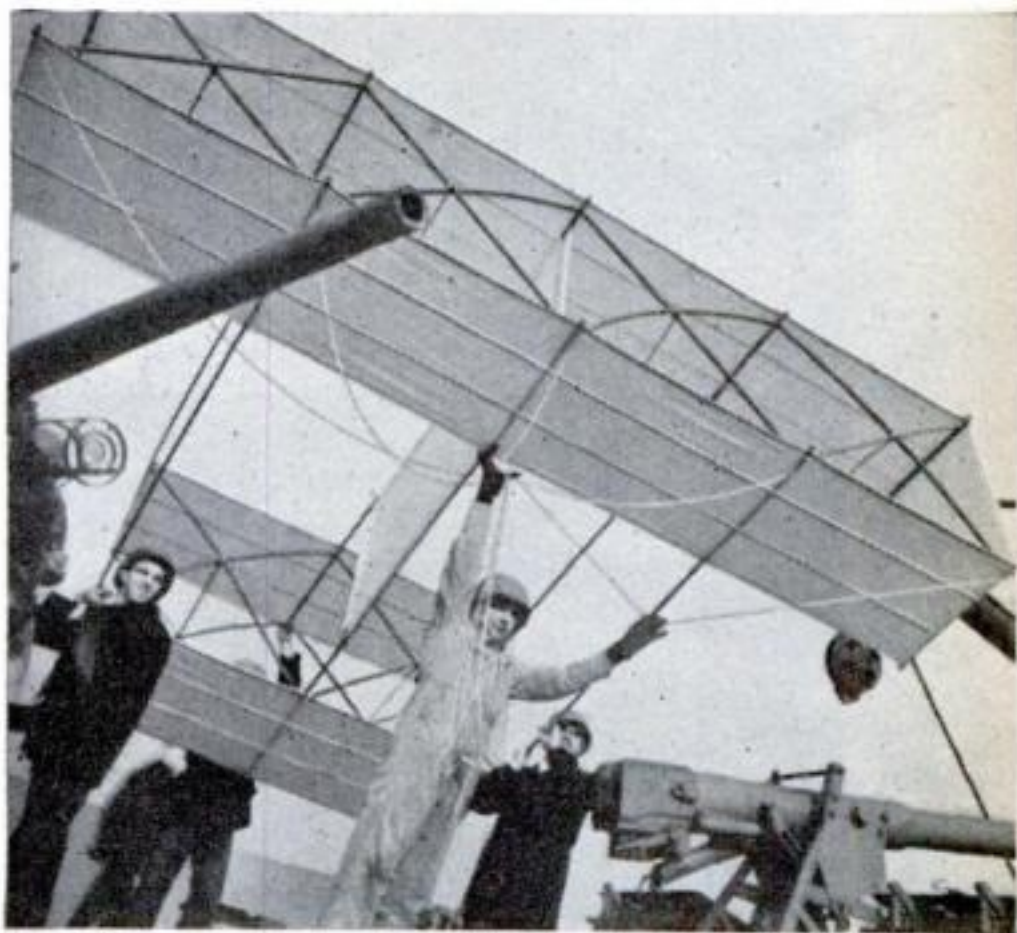
Copy of the Kites That Guard Freighters Against Bomber Attack

Pull the cord taut and double it back around the other nail, as in Fig. 3. Holding the doubled portion firmly, slip the cord off the nail and tie a bowline to form a loop like the first one. By varying the distance between the nails, you can similarly form the horizontal and diagonal ties.

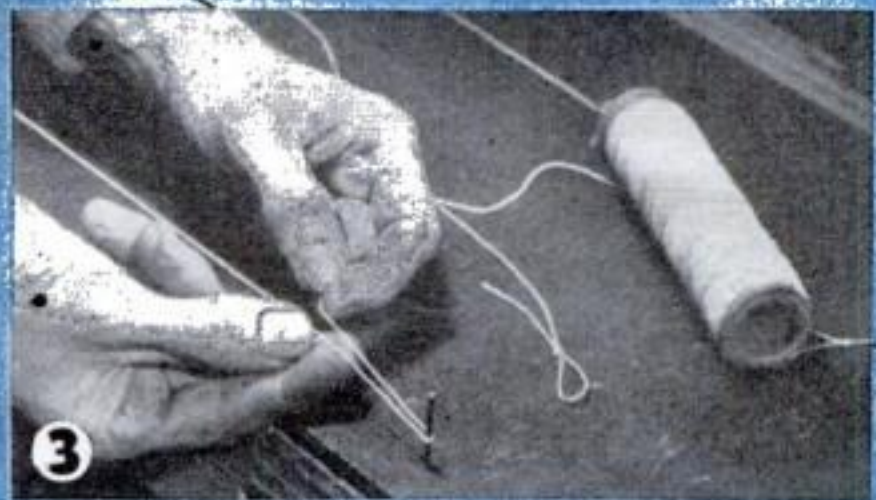
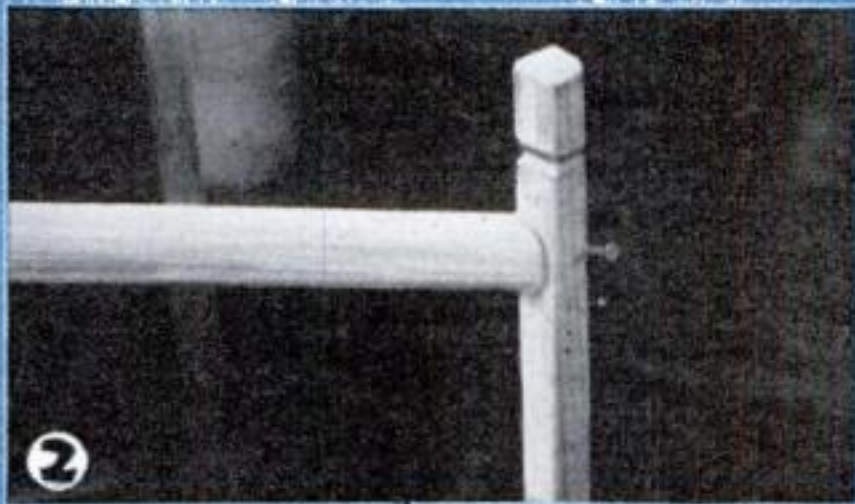
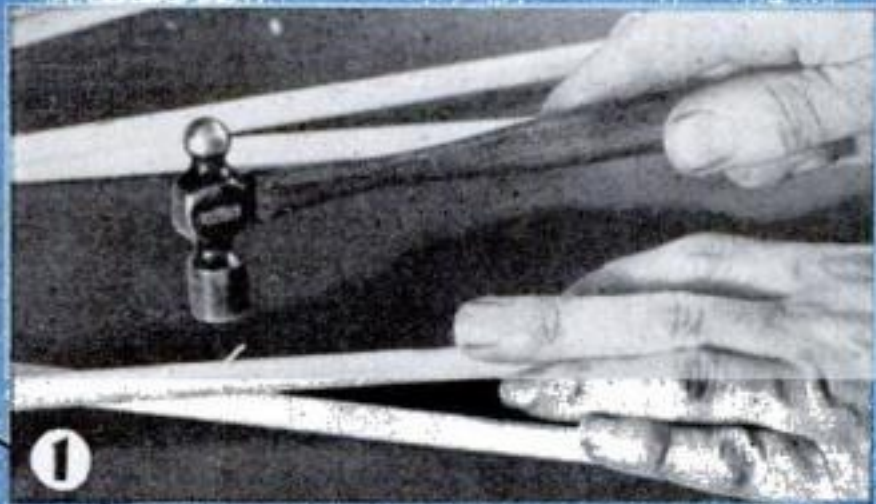
Make shallow notches near the ends of the longerons to hold the cords. Slip each cord over the proper longerons, as in Fig. 4, and secure it with a touch of glue. A completed wing section, ready for covering, is shown in Fig. 5.

The two tail sections are assembled in the same manner as the wing sections except that there are no diagonal cords or wooden tie rods. An assembled tail-section frame is shown in Fig. 6.

To tie the wings and the tails together, make a stabilizer section. It consists of two longerons and two vertical struts. Crossed diagonal cords stiffen the frame. Nail a small metal disk to the front end of the upper longeron to keep the wings from moving

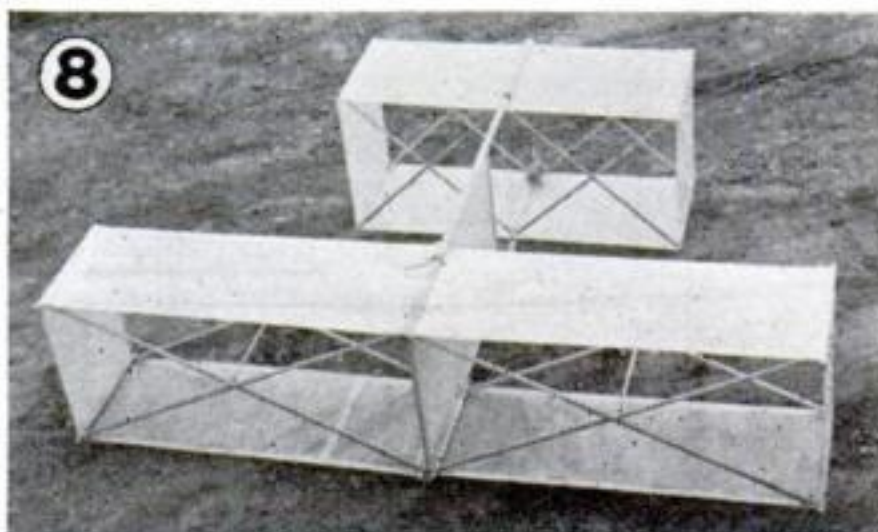
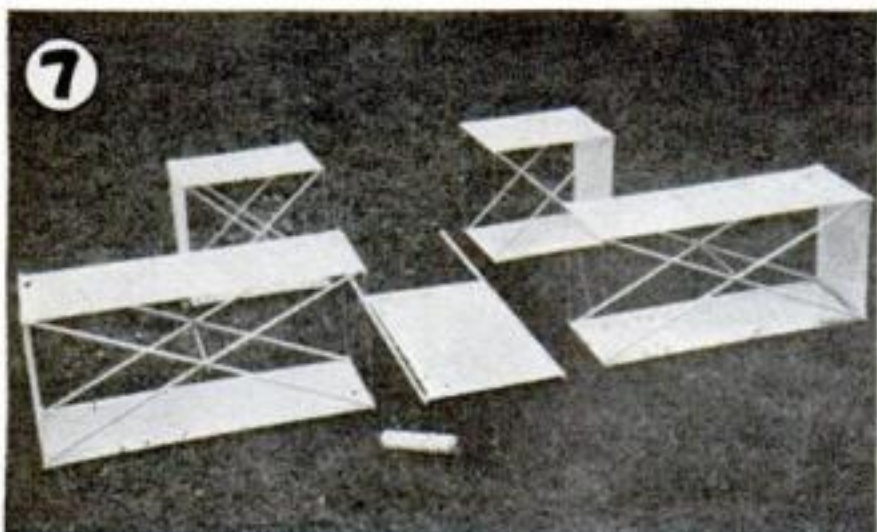
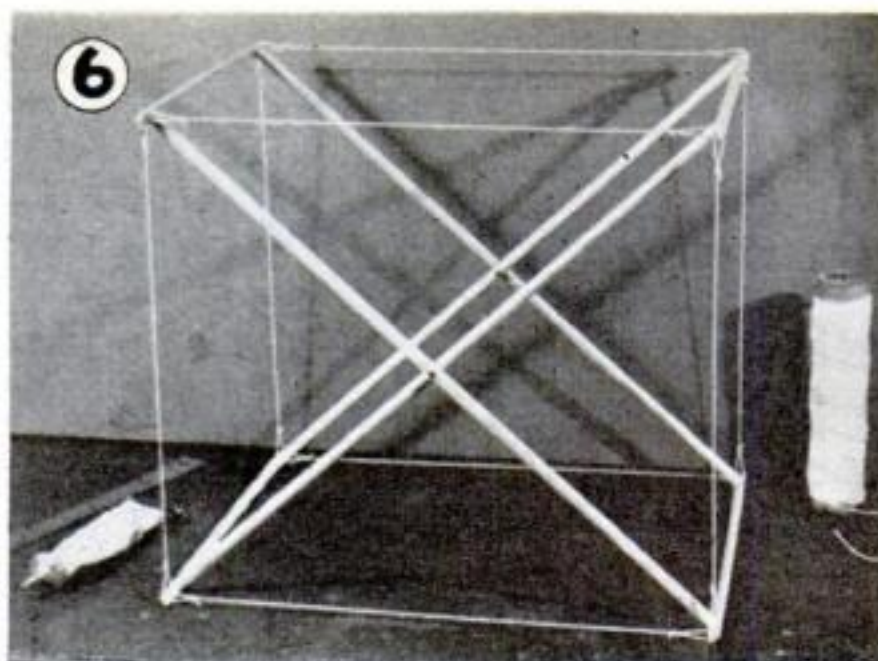
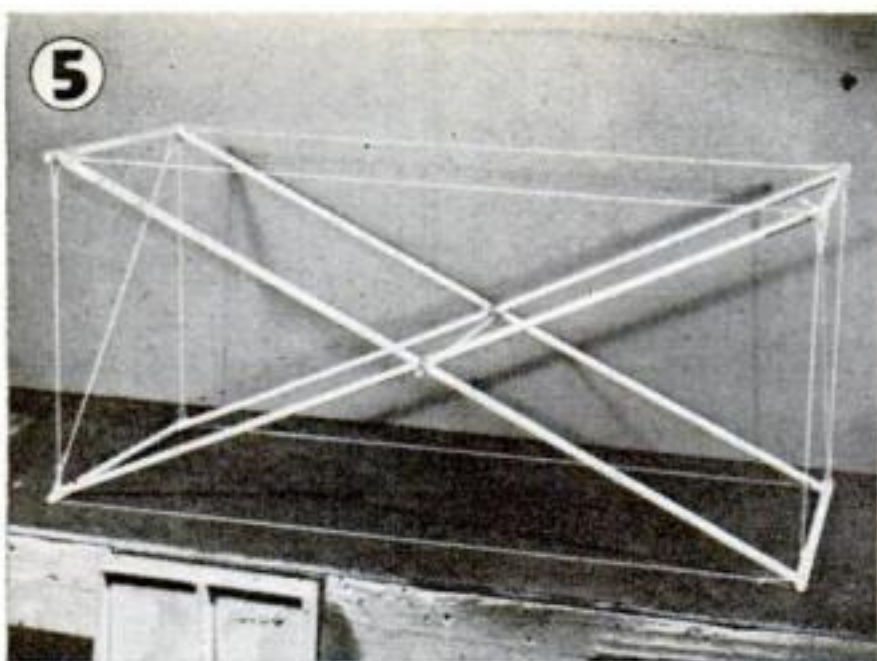


Above, how sailors launch a full-size barrage kite from the deck of a ship to ward off enemy bombers



NOVEMBER, 1944





too far forward and possibly slipping off.

When the wings are put in place, the wing longerons will rest against the stabilizer longerons with the front vertical strut holding them slightly apart. Small brads driven into the stabilizer longerons serve similarly to space the trailing edges of the wings. Additional brads act as stops to prevent the wings from slipping back along the stabilizer.

Cover the top, the bottom, and one end of each wing and each tail, and the portion of the stabilizer between the vertical struts, with paper or muslin. Cut the covering material $\frac{1}{2}$ " wider than the space it is to occupy. To cover the wings and tails, fold the edges of the covering material around the cords and secure them with glue; then glue the covers to the longerons. To cover the stabilizer, run lengths of reinforcing cord between the two tops and between the two bottoms of the vertical struts; then glue the cover to the cords and to the struts. If you use tissue paper, you can strengthen it now by applying a coat of linoleum lacquer to it. The kite should then look as shown in Fig. 7, and is ready for assembly.

Punch small holes in the covers $1\frac{1}{2}$ " from the ends of the wing and tail longerons that butt against the stabilizer and reinforce them with glue or lacquer. Through these holes go 12 cords to bind the kite together. Four are used to fasten the tail sections to each other; four more pass through the same holes and tie the tails to the sta-

bilizer; and the remaining four are used to hold the wings to the stabilizer. The assembled kite will look like Fig. 8. It may be disassembled for storage or transportation by cutting away the 12 cords just mentioned.

At the front end of the lower stabilizer longeron and each outer, lower wing longeron attach a small wire or cord loop to take the ends of three bridle lines. These lines come together about 3' in front of the kite, where they are tied to a ring or a loop. The kite line is also tied to this ring or loop, or it may be fastened with a small snap hook.

The kite is now ready to be flown. Wait for a fairly breezy day. Stay well away from woods or other obstacles that might cause gusty air currents. Let out about 50' of cord and have an assistant hold the kite at head level, pointing it upward at an angle of about 45 deg. Hold the line moderately taut. When the breeze is good, take a short run. The kite should rise immediately and continue to climb as you pay out line. If it rides on too even a keel, it may overrun you and go into a dive. To remedy this, add weight to the tail, an ounce at a time, in the form of lead sinkers or blocks of wood that are held in place by string. The kite illustrated showed a pull estimated at 10 to 15 lb. during the test flight, which was made in a fairly stiff breeze.

It is a good idea on flight expeditions to take along some spare covering material, cord, and quick-drying cement for making emergency repairs.

What Can You Make of Cardboard?

\$50 CONTEST

Cash Awards for the Best Entries

HAVE you ever tried working with cardboard? It can be a fascinating hobby, and you may be surprised by the useful, attractive, and remarkably sturdy articles you can make. To stimulate interest in cardboard projects, POPULAR SCIENCE MONTHLY is offering \$50 in cash prizes for the best eight articles made from cardboard. The awards will be as follows:

First Prize	\$25
Second Prize	\$15
Third Prize	\$5
Five Prizes	\$1 each

Entries will be judged on design, originality, and craftsmanship. No material other than cardboard will be allowed, but any kind of fastener may be used. In case of ties, each tying contestant will be awarded the prize for which he is tied.

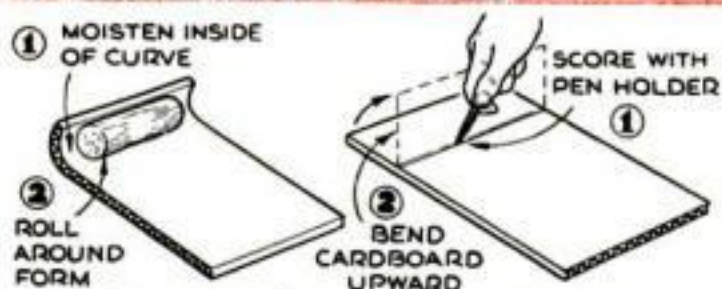
Only one entry will be considered from each contestant. Pack yours carefully and mail or express it to the Cardboard Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N.Y., to arrive on or before January 15, 1945. The article itself must be submitted, not a photograph. No entry will be returned. Judges will be the editors of this magazine, and their decision will be final. The contest is open to all except employees of this publication.

In cutting cardboard, use a sharp knife or razor blade with a metal-edged ruler as a guide. Make several light strokes rather than a single heavy stroke. Corrugated cardboard can be bent by first scoring it with several firm strokes of a rounded point, such as the tip of a penholder, while using a ruler as a guide. Take care not to cut into the material. Bend along the scored line. When marking measurements, bear in mind that the inside dimension at a bend will be diminished and the outside somewhat increased. For rounded bends,

moisten the inside of the curve and bend gradually in line with the corrugations, using a cylinder as a guide.

Several methods of joining and edging are shown in the drawings. Rolled and triangular edges add strength. Two thicknesses glued together with the corrugations at 90 deg. make a sturdy piece.

For a finish, try show-card colors coated with clear lacquer or varnish.



BENDING CORRUGATED CARDBOARD



REINFORCING EDGES



JOINING EDGES

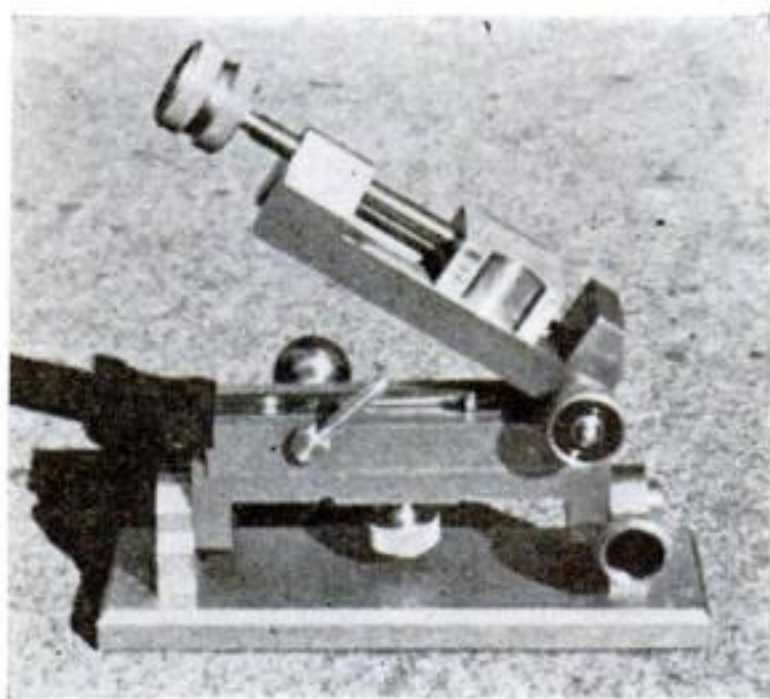
MAKING SOLID FORMS



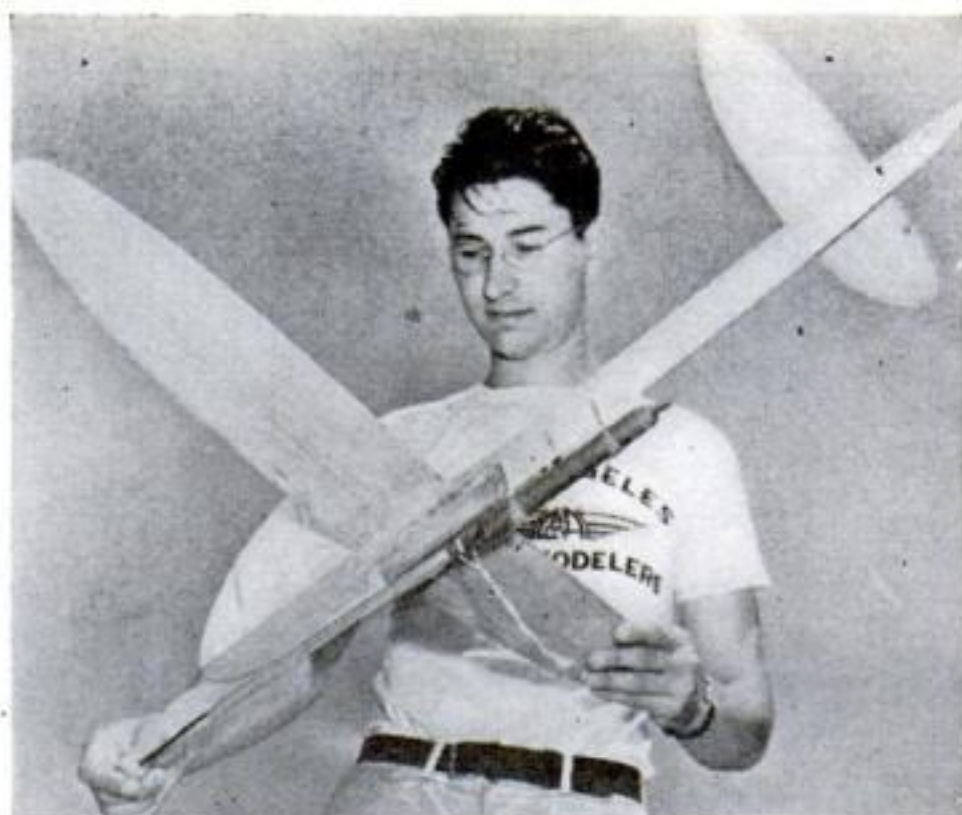
Many projects such as this sturdy table and the vase can be made of cardboard. Study these; then create your own designs

CRAFTSMEN AT WORK

MAKING LEAF SILHOUETTES is the hobby of Dr. Adrian Lewis, a professor at Manhattan College, New York City. His painstaking technique involves using sharp-pointed instruments to scrape away the leaf's surface to the depth required for the desired shading effect. The scene below depicts Boston College at night.



PRECISION-BUILT of cold-rolled steel by Pfc. Anton M. Ryzak, this toolmaker's vise rotates through 360 deg., tilts 180 deg., and can be elevated as much as 45 deg. Handwheels are provided to lock it in any position. It is used for laying out work and for compound-angle grinding.



THIS MODEL ROCKET PLANE was built by Duke Fox, of Los Angeles. Here he is preparing to light the rocket fuse for a flight.

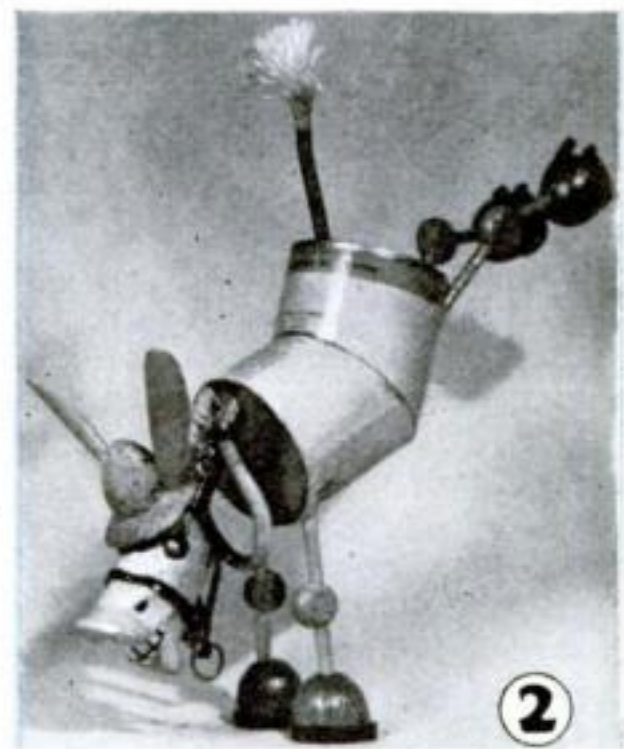
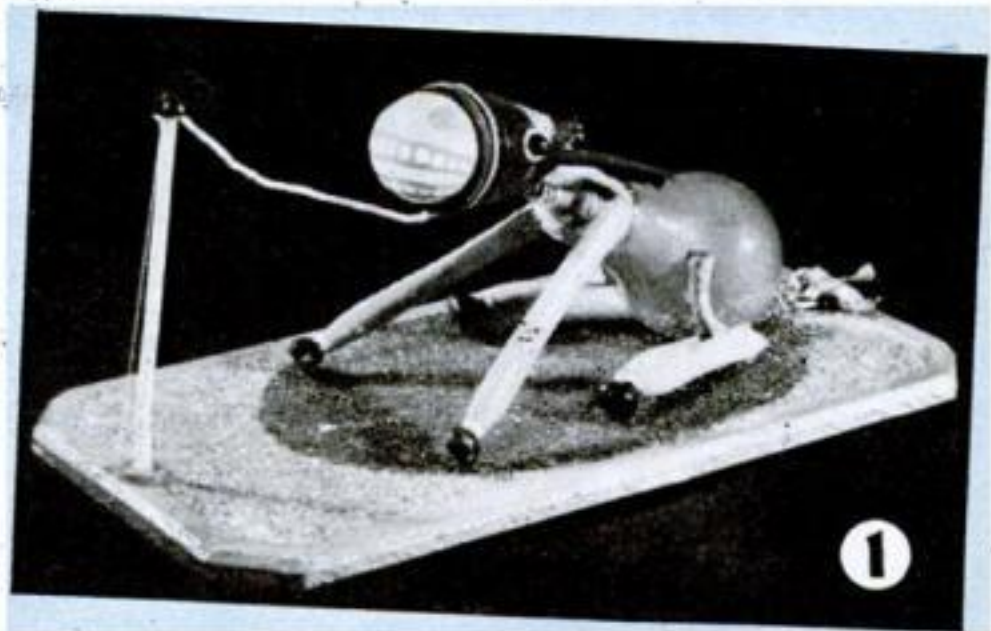
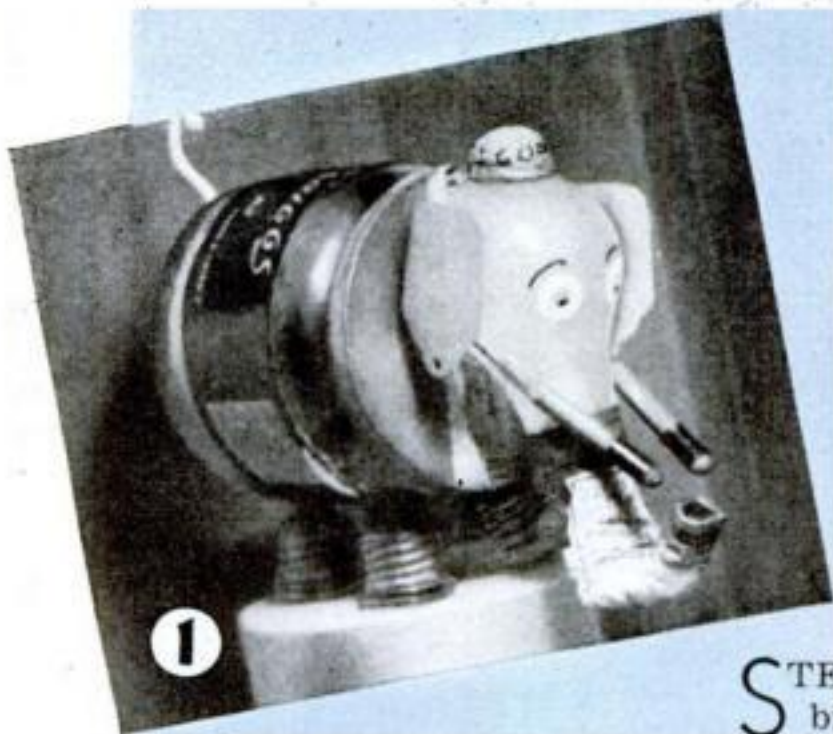


OPERA STAR Herta Glaz is an amateur woodworker. In her spare time, she builds furniture for servicemen's recreation rooms.

EGGSHELL PAINTER Tom Jackson, 12, of San Francisco, has produced caricatures of many famous people, including Mae West and Hitler.



BIZARRE ANIMALS WIN PRIZES



STEP this way to the big tent! See the goofy animals, rampant after their struggles on the political battlefields! Conceived in the imagination of P.S.M. readers and born of materials from the wastebasket and workshop, these freak fauna are the top winners in our recent \$100.00 contest for the best Republican elephant and the best Democratic donkey made from odds and ends. A full list of the winners appears below.



BEST REPUBLICAN ELEPHANT

1st Prize: O. I. Price, Jr., Frederick, Md.
2nd Prize: Harry Beeler, Hollywood, Calif.
3rd Prize: Miss Halpin Abbott, Dallas, Tex.
4th to 8th: J. H. Madison, West Hartford, Conn.; Pvt. Baker Hendershot, Selma, Ala.; Ruth Walker, Hicksville, N. Y.; S. F. Sicko, Holyoke, Mass.; Bill Insley, Indianapolis.

BEST DEMOCRATIC DONKEY

1st Prize: E. B. Kostek, Chicopee, Mass.
2nd Prize: H. O. Henderson, Phillips, Tex.
3rd Prize: Mrs. Roy Clark, Wichita, Kan.
4th to 8th: Nelson Valade, Providence, R. I.; J. C. Lamons, Knoxville, Tenn.; Mrs. Goldia Wooten, Norton, Kan.; L. J. Bowers, San Diego, Calif.; C. D. Ingram, Dallas, Tex.

Nautical Book Ends for the Armchair Mariner

By

JOHN J. GALLIVAN

THE ACRID aroma of black-powder smoke and the screaming sound of a broad-side of round shot are vividly suggested to ship lovers by these early naval cannon. Mounted on weighted book ends, they will make an attractive addition to almost any living room or den.

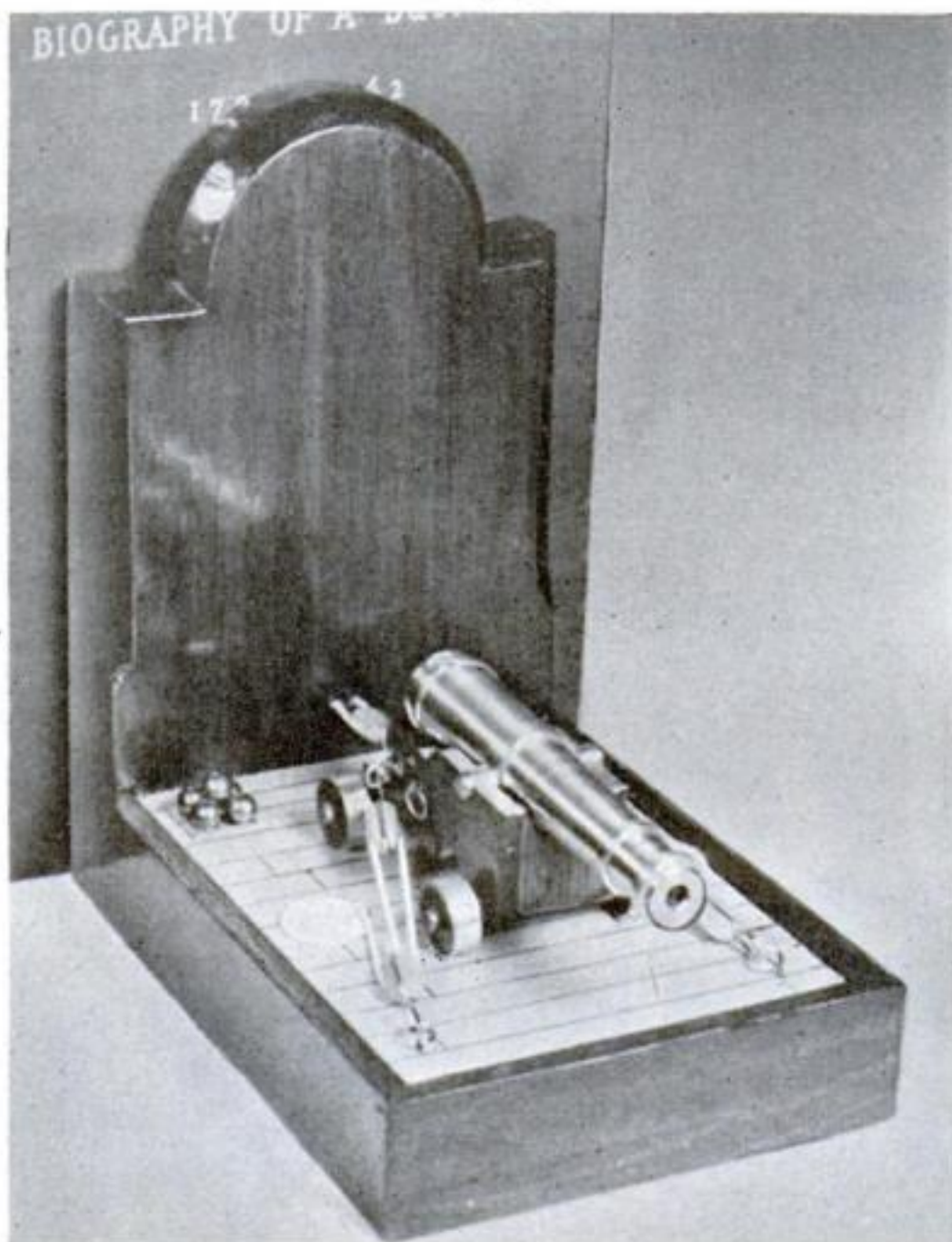
Turn the barrels in a lathe, using brass, mild steel, or wood. Drill two $\frac{1}{4}$ " holes in each—one laterally through the barrel to take the trunnion peg, which should be a drive fit because in the original it was cast as an integral part of the barrel; and one in the outboard end, 2" deep, to simulate the bore.

Build the carriages, or trucks, from $\frac{3}{16}$ " stock, with the exception of the rear filler blocks, which are made of $\frac{5}{16}$ " material. Apply glue to the joints and set the assemblies in clamps until they are thoroughly dry.

Cut the eight wheels from $\frac{5}{8}$ " hardwood doweling and fit them on the turned ends of the $\frac{3}{16}$ " by $\frac{3}{16}$ " by $2\frac{1}{8}$ " axles. Glue lead-foil edging on the carriages and on the rims of the wheels. Finish the woodwork with red mahogany stain, wiping it off immediately after applying it to give a light honey color. Set the barrels in place and apply lacquer to both completed assemblies.

You may purchase ringbolts and blocks ready-made or, if you prefer, you can make your own. Use paper-clip wire for the rings and fabricate the blocks from $\frac{3}{16}$ " by $\frac{5}{16}$ " stock, as shown. Paper-clip wire is also suitable for the straps.

Make the decks and the bottoms of the book-end bases of $\frac{3}{16}$ " plywood. Rule in the deck seams with a drafting pen and fin-



Quoins, or elevating wedges, were used on early cannon such as these to adjust the trajectory of the round cannon shot

ish the decks with several coats of varnish or lacquer.

Fasten the cannon-and-carriage assemblies to the decks by drilling two small holes through the decking directly under each trunnion pin, about $\frac{1}{2}$ " apart, and passing a light wire under each barrel in front of the trunnion; then over the trunnion each side of the barrel; then down through the holes. Put a small scrap of sheet metal between the holes on the underside of each deck and tighten each wire by twisting the ends together.

Use mahogany or other suitable cabinet wood for the sides of the bases and the back

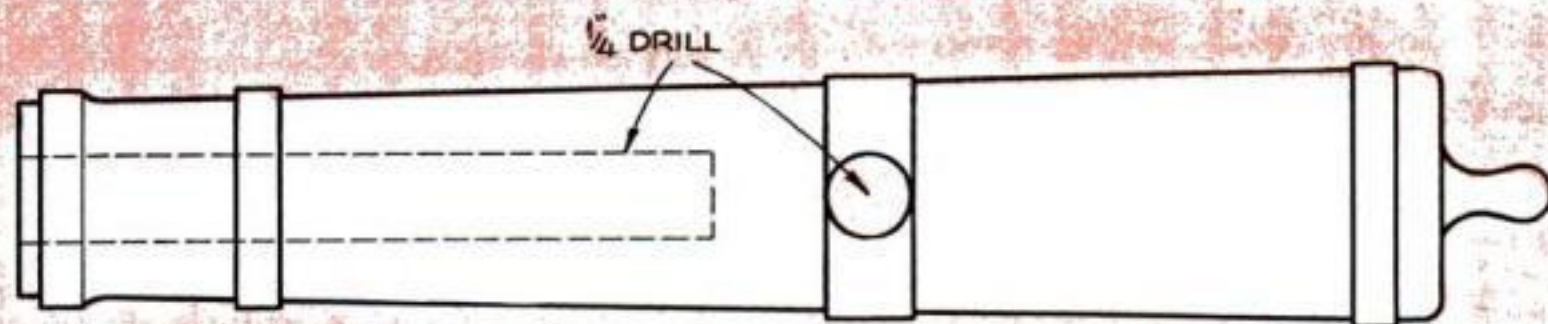
pieces. Rabbet the sides and shape and bevel the backs, as shown. To assemble, use glue and light finishing nails.

Since weight is important in book ends, fill the hollows in the bases with ballast. This may be in the form of brads, shot, or linotype leads. Fix it in place by pouring melted wax over it.

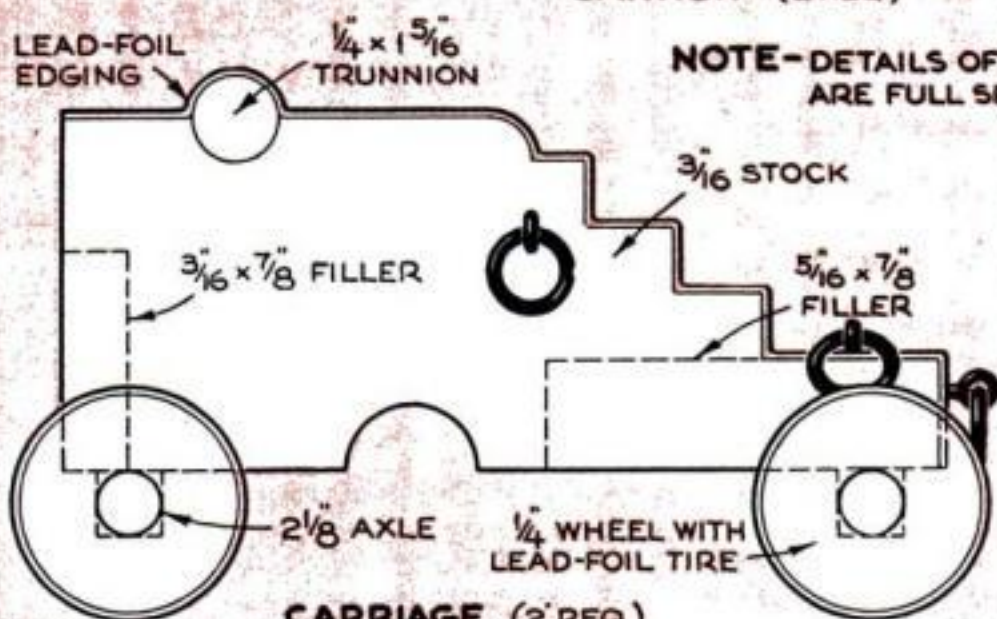
Drill two rigging holes in each back; then cut a groove between these so the tackle

line will not cause a lump under the felt backing. Each book end has one withdrawing-tackle and two side-tackle assemblies, which are rigged as shown in the lower right-hand drawing. A spot of glue here and there will serve to keep the blocks and rigging in the proper place.

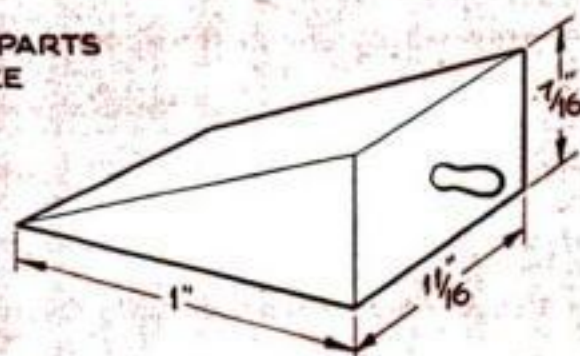
Cannon balls are ball bearings set in racks. Glue felt under the base and to the inside of each backing piece.



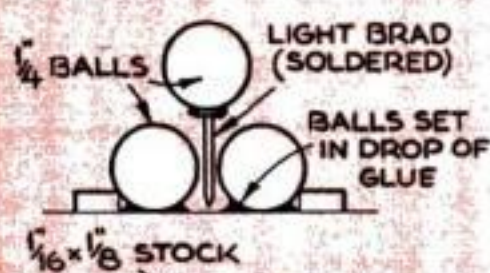
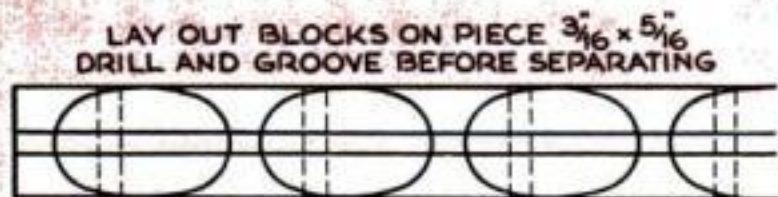
CANNON (2 REQ.)



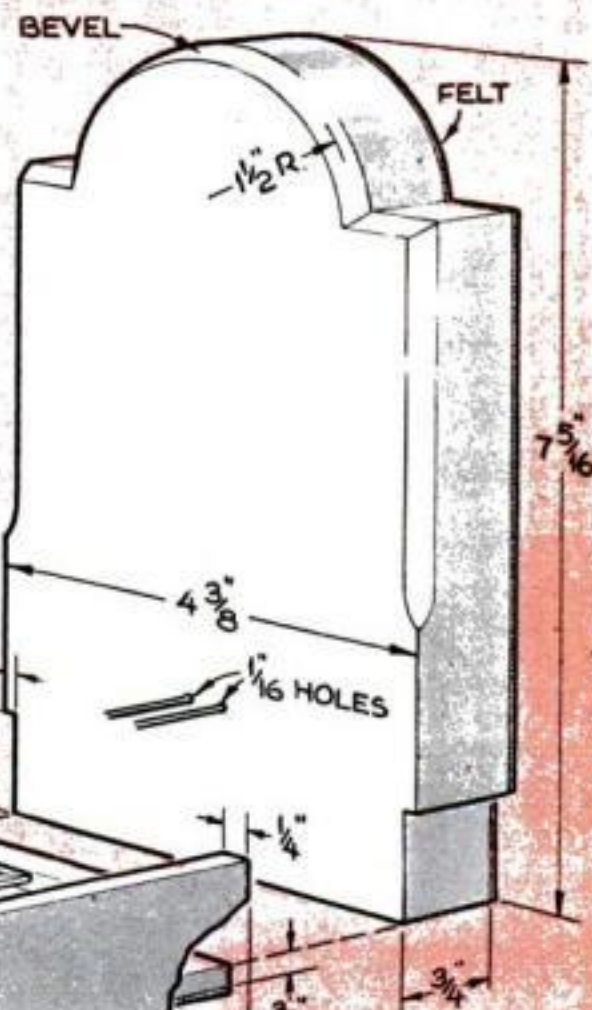
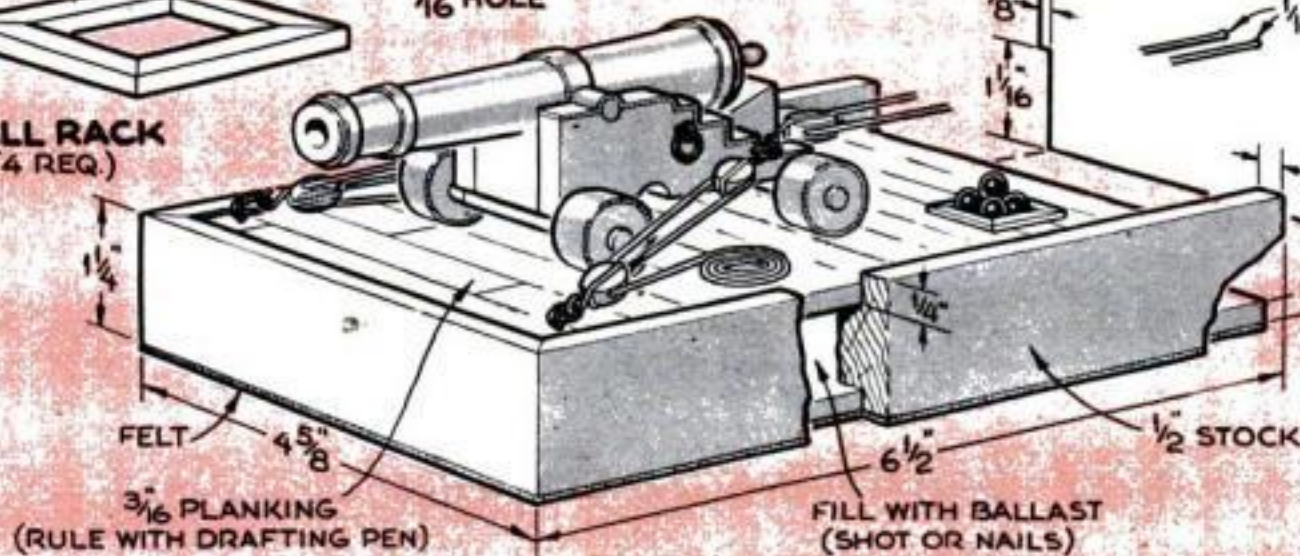
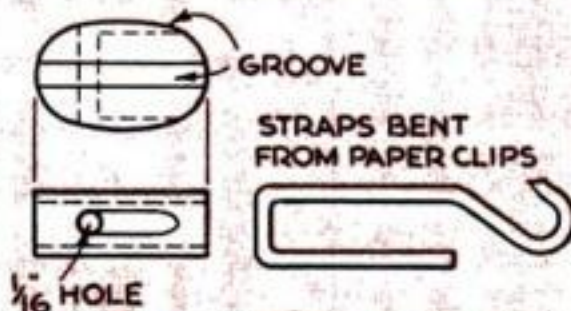
CARRIAGE (2 REQ.)

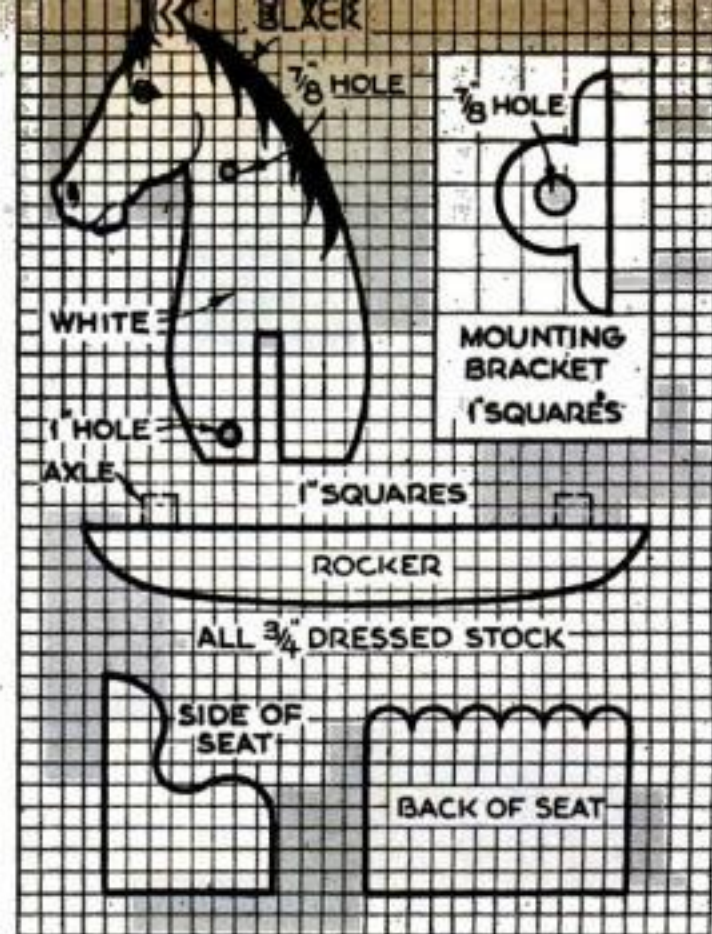
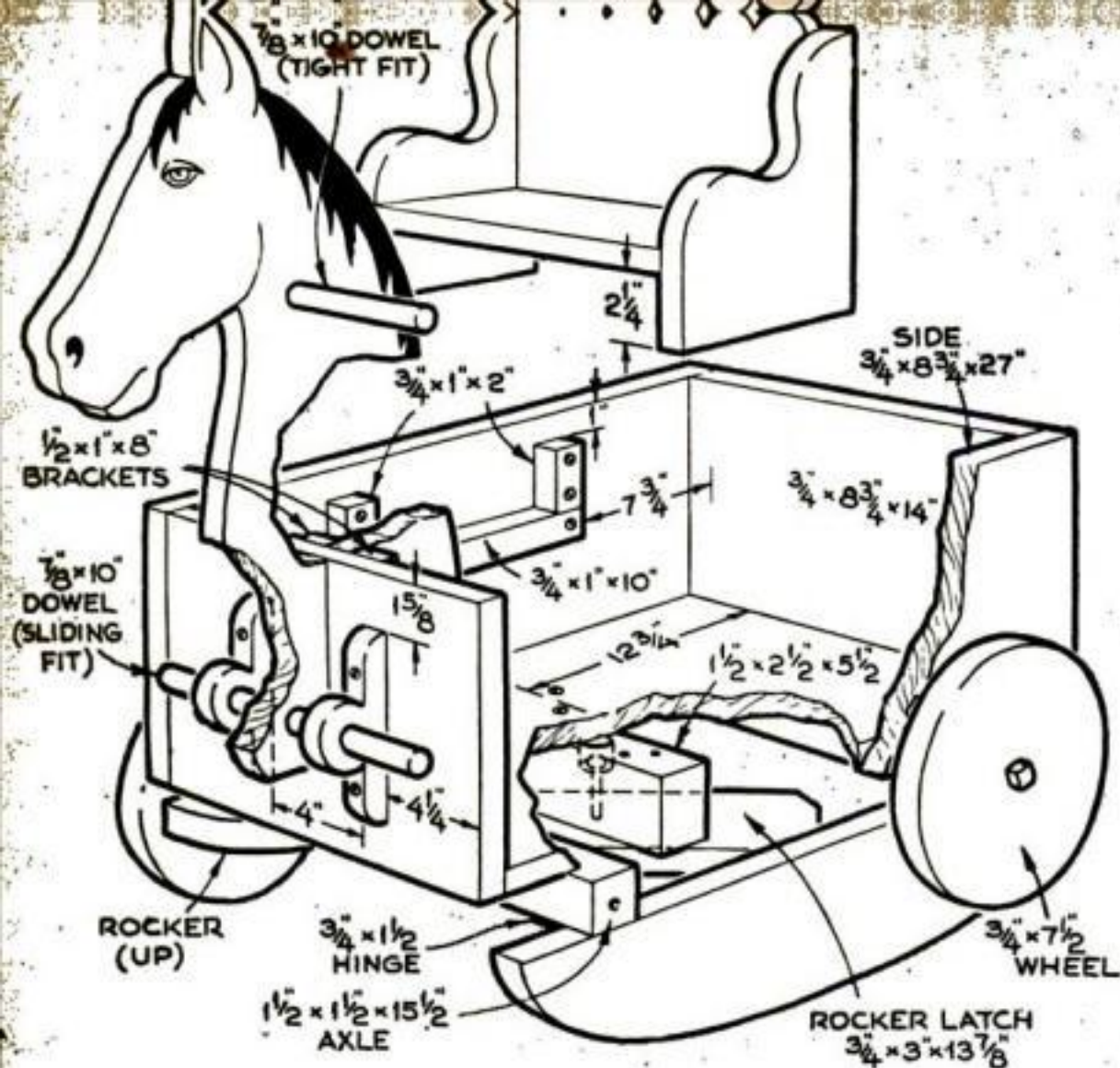


ELEVATING WEDGE (2 REQ.)



BALL RACK (4 REQ.)





Combination Wagon and Hobbyhorse Is Two-in-One Toy for Youngsters

WITH the rockers folded up out of the way, this toy is a wagon; with them let down, it becomes a hobbyhorse. Almost any boy or girl from two to five years old would love to find it waiting under the tree on Christmas morning.

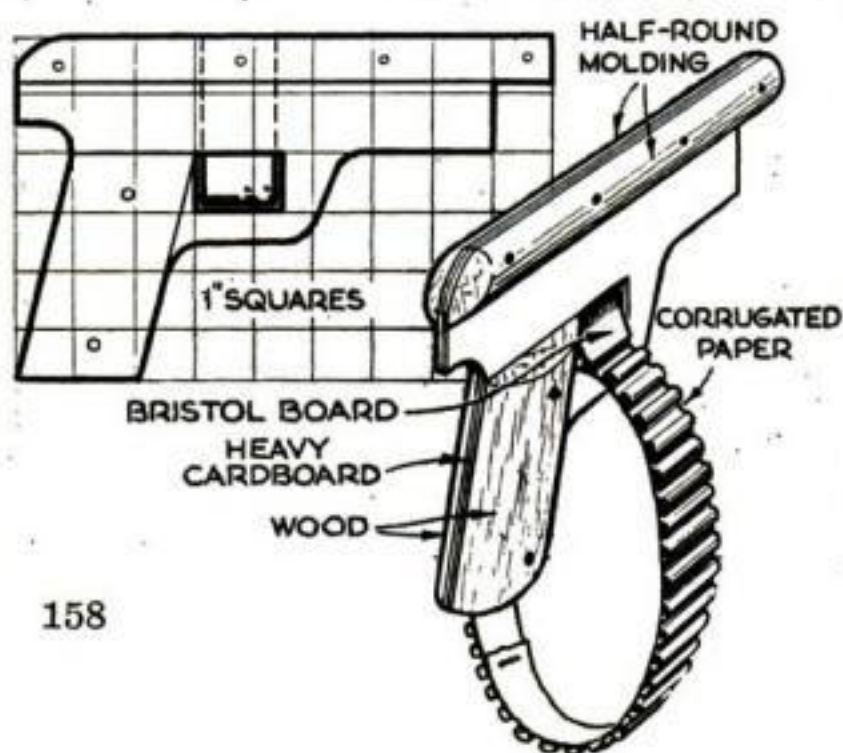
The chief material used is $\frac{3}{4}$ " dressed stock. From this the box, horse, seat, wheels, rockers, rocker latch, and brackets are made. A power jigsaw is handy when cutting the curved pieces, but hand tools are sufficient if one is not available. The axles are made from $1\frac{1}{2}$ " by $1\frac{1}{2}$ " stock. The rocker latch pivots about a carriage

*MAKE IT NOW
for Christmas*

bolt that is set in a $1\frac{1}{2}$ " by $2\frac{1}{2}$ " support. A $\frac{7}{8}$ " dowel holds the horse in place and another one goes through his neck to provide a hand hold. The wheels are fastened to the axles with $\frac{1}{4}$ " by 3" lag screws.

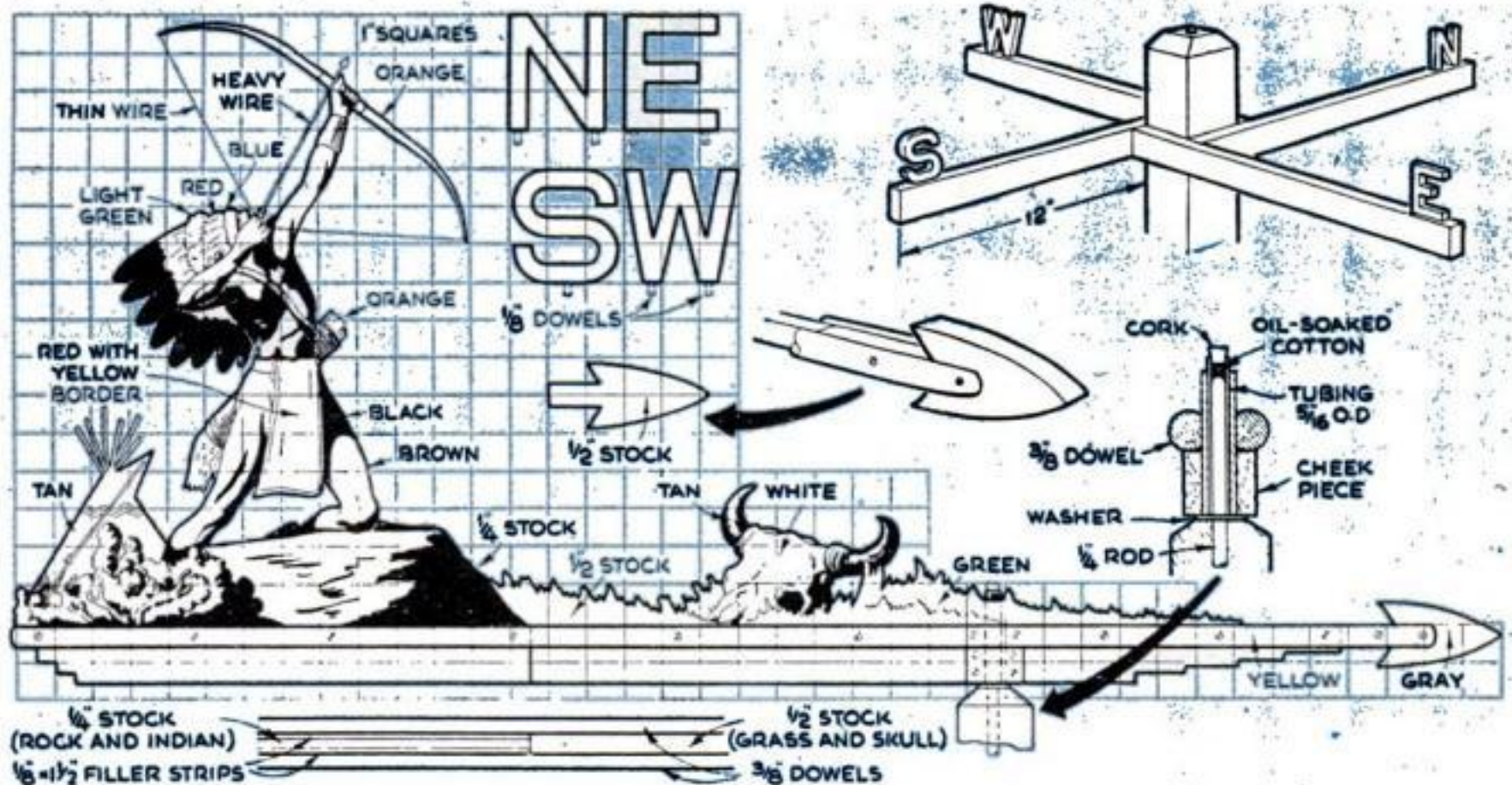
Finish the toy in bright, contrasting colors and name it after the child for whom it is made—for instance, "Roger's Ranger," "Penny's Prancer," "Susan's Sea Biscuit," or "Danny's Dobbin."—L. R. TREINIS.

Cardboard Pistol Gives Realistic Machine-Gun Sound Effect



THIS automatic pistol, which can be assembled in a few minutes, is one of those perennial favorites, a noise maker. Two pieces of heavy cardboard form the frame. The clacker may be Bristol board, as suggested, or celluloid. The cartridge belt is a length of corrugated paper. Two pieces of half-round molding make the barrel and two shaped pieces of wood form the grip. After assembling the pistol, staple the ends of the belt together. When it is pulled through the trigger hole, the clacker vibrates, emitting a realistic clatter.

Indian Motifs Are Incorporated in Distinctive Weather Vane



IF YOU treat him well, the Indian chief on this vane will reciprocate by shooting holes in the clouds when your Victory garden needs rain and by frightening the clouds away when you are entertaining outdoors.

The figure, the rock on which it is kneeling, and the sagebrush and tepee behind are jigsawed from $\frac{1}{4}$ " stock, preferably plywood. Use $\frac{1}{2}$ " material for the grass and

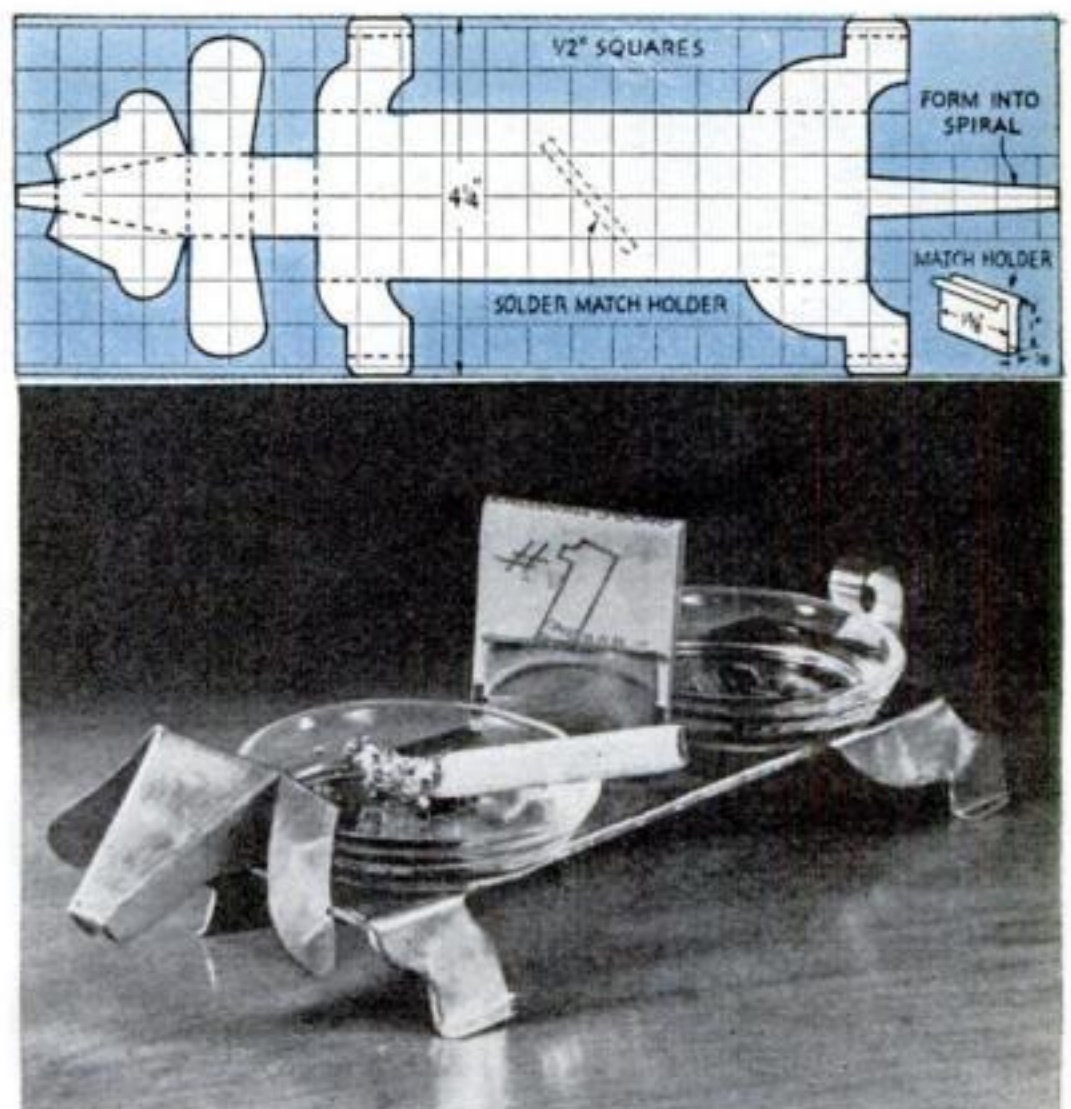
skull in the foreground, as well as for the arrowhead at the front of the vane. Two lengths of $\frac{3}{8}$ " dowel, flattened on one side, extend back from this arrowhead along the vane. Use $\frac{1}{8}$ " filler strips as shown.

Paint the vane—the colors indicated make an effective combination—and mount it as shown. Cut the arms and letters from $\frac{1}{2}$ " stock and nail to the pole.—GRAY WOLF.

Decorative Ash-Tray Holder Is Made from a Discarded Tomato Can

THIS unusual dachshund can be made in an hour or so from a large tomato can. Prepare a pattern on stiff paper, using the drawing as a guide. Cut open and flatten the can, taking care not to dent it. Trace the pattern on the tin and cut it out. Then bend the material as indicated by the dotted lines in the drawing, using a pair of flat-nose pliers and working slowly.

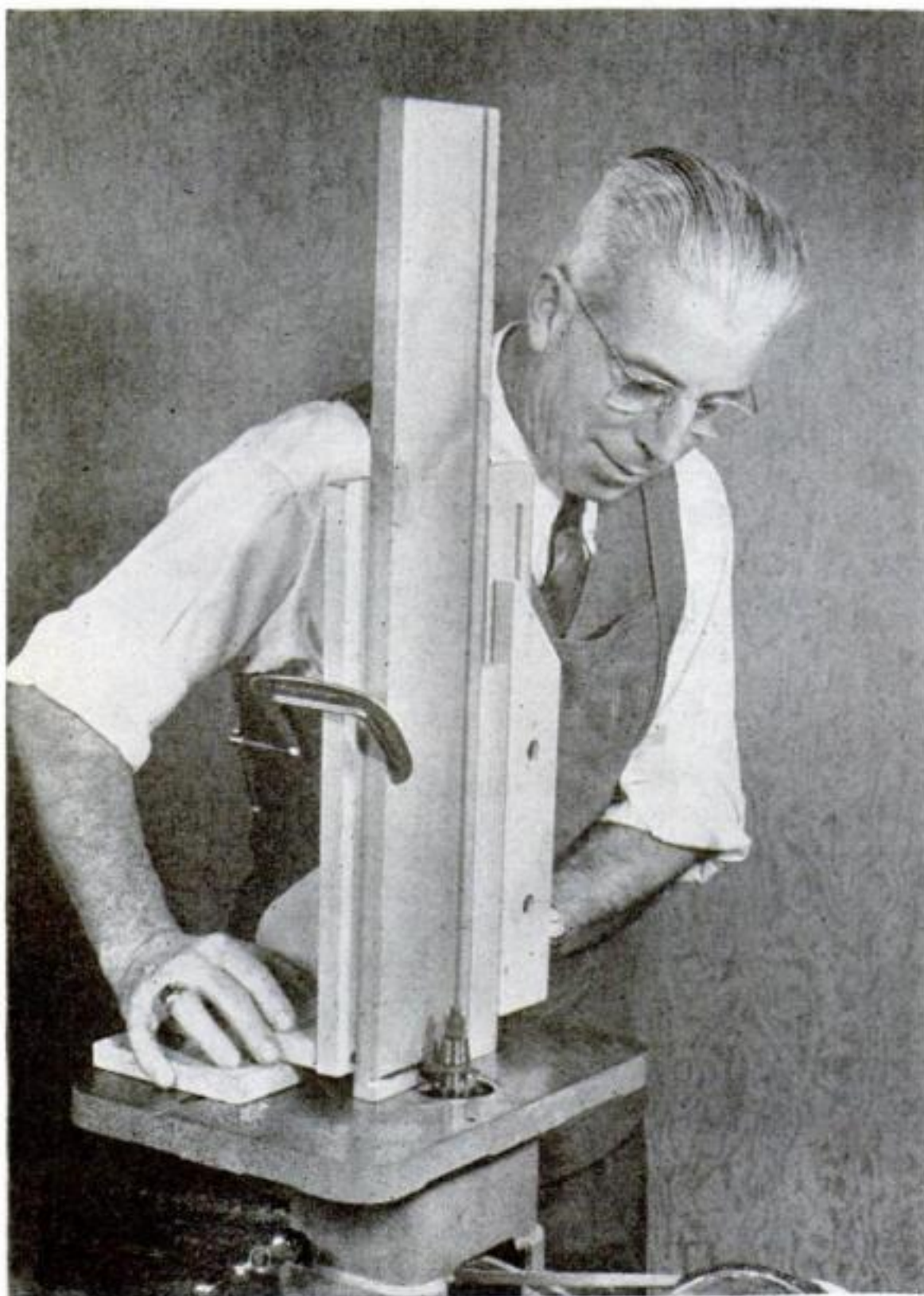
Make the match-packet holder from the top or the bottom of the can. The circular depressions stamped in the can ends may be utilized to add a modern decorative touch. Solder the holder to the back of the dachshund, taking care not to get excess solder where it will show. Polish the project with fine steel wool and give it a coat of clear lacquer to make it gleam like silver. Small individual glass ash trays may be placed, singly or in nests, on the dachshund each side of the match holder.—C.W.B.



JIGS ADAPT A SHAPER

By

EDWIN M. LOVE



Sliding in the groove on a shaper table, the vertical jig is used here in working the side of a cabinet part. The L-shaped section is bolted to a sliding base, and it is adjustable for depth of cut

drawing. The L-shaped section is slotted for bolting to a base that slides in the shaper-table groove, and it is adjustable for distance from the cutter, while the vertical face is slotted for holding a fence in either of two positions. Such a jig is useful for grooving drawer sides, cabinets, and the like, and for making end rabbets, stub tenons, and wedge-shaped tenons.

What is a horizontal sliding jig? A convenient one is shown in a drawing. The screw clamp can be cut from a C-clamp or an old clothes-wringer clamp. Remove the swivel foot by bending out one of the ball tabs and twist the screw into a center hole in the hardwood block, thus cutting threads. Replace the foot and bend the tab back against the ball of the screw.

One photo shows such a jig used in continuing on the end of a piece of work a molding that has been cut in the sides. For a mitered end, the gauge head would be swiveled to suit. Similar setups are used for such jobs as tonguing and grooving the ends of hardwood

FOUR shaper attachments of exceptional value are a vertical sliding jig, a horizontal sliding jig, a radial arm, and a fluting jig. With them it is possible to do easily tasks that would otherwise require elaborate fixtures or special setups. A fluting jig that can be built in the home workshop is equipped with a dividing head that makes it useful for a variety of work. The radial arm, used with the dividing head and either with or without the vertical jig, is helpful when ornamental carving is to be done.

How is a vertical sliding jig made? This jig is built in three parts, as shown in a

flooring or cedar-closet lining, and for cutting limited-length stub tenons. The ends of segments of circles can also be worked if the pieces are properly blocked. A backing piece is always needed against the edge the cutter leaves to prevent splintering.

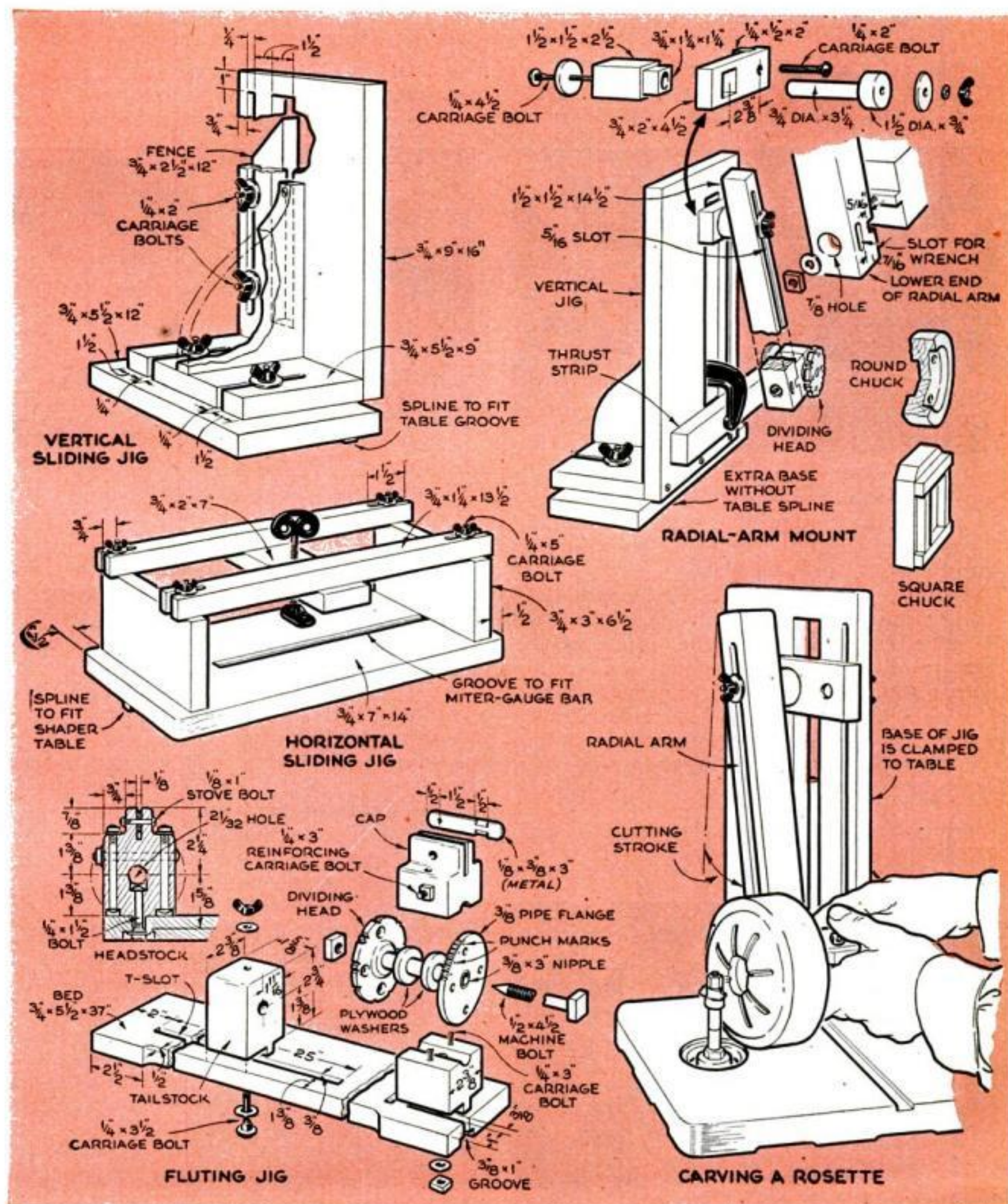
Is a fluting jig difficult to build? Besides the dividing head, the only pieces required are a simple base, an adjustable tailstock, and a removable headstock. The tailstock carries a tapered lathe dead center or a $\frac{1}{2}$ " rod on which a cup center can be locked, while the headstock has a pointed bolt for a center or a blunt bolt to which a clamp-on spur center can be attached.

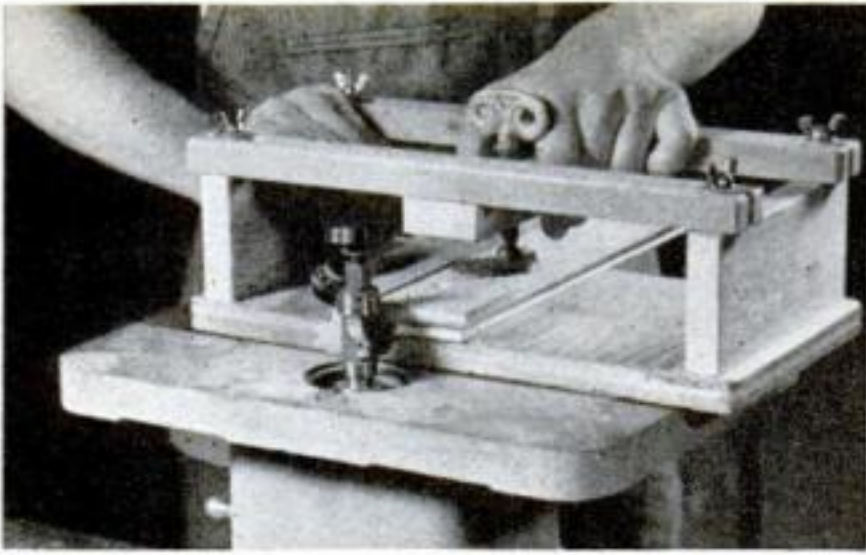
TO SPECIAL JOBS

Make the dividing head of two pipe flanges and a pipe nipple. To index it, screw one flange on the nipple and mount it on a wooden chuck fitted with a dowel on which the nipple can be centered. File the edges smooth; then, using the lathe indexing attachment, mark off 60 spaces, notch with a

hacksaw, and file the notches V-shaped. Repeat for the other flange, making both seven and eight divisions on it. A paper pattern helps in laying out seven divisions. File the center-bolt point and taper in the lathe.

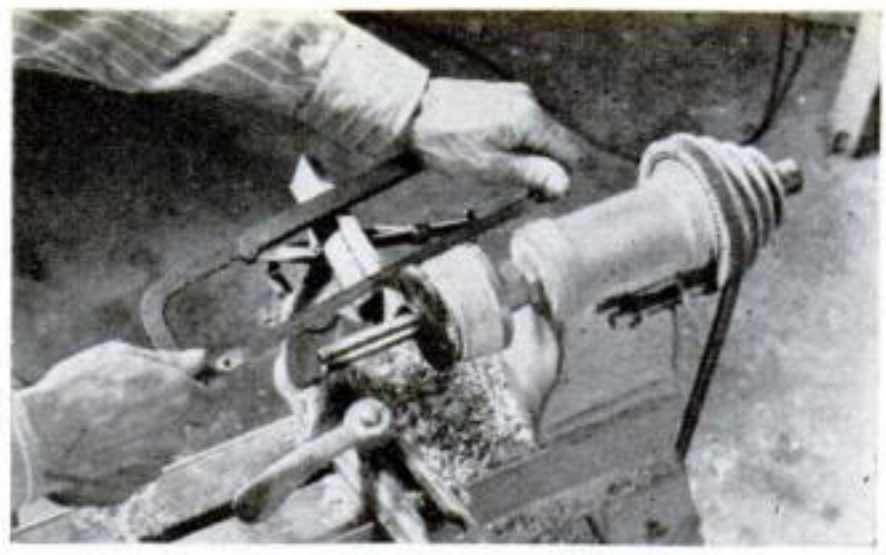
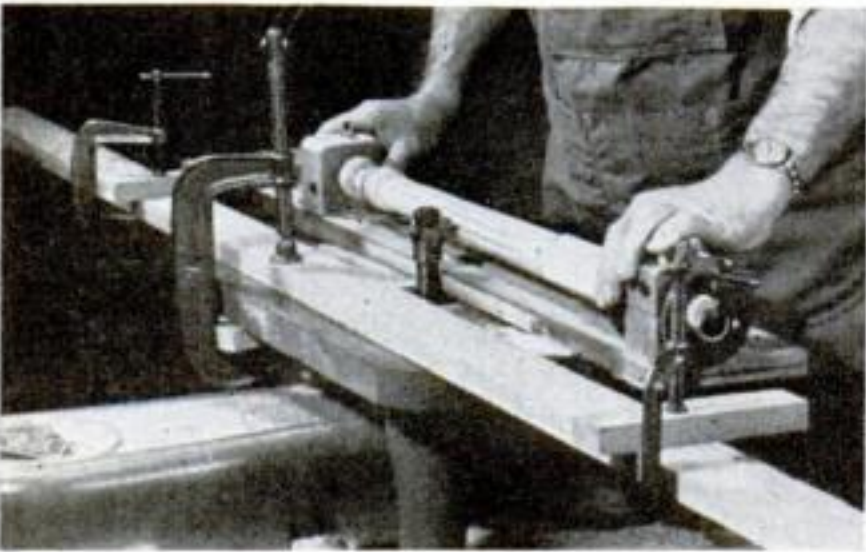
How is the fluting jig used? Clamp the nipple in the headstock tight enough to re-





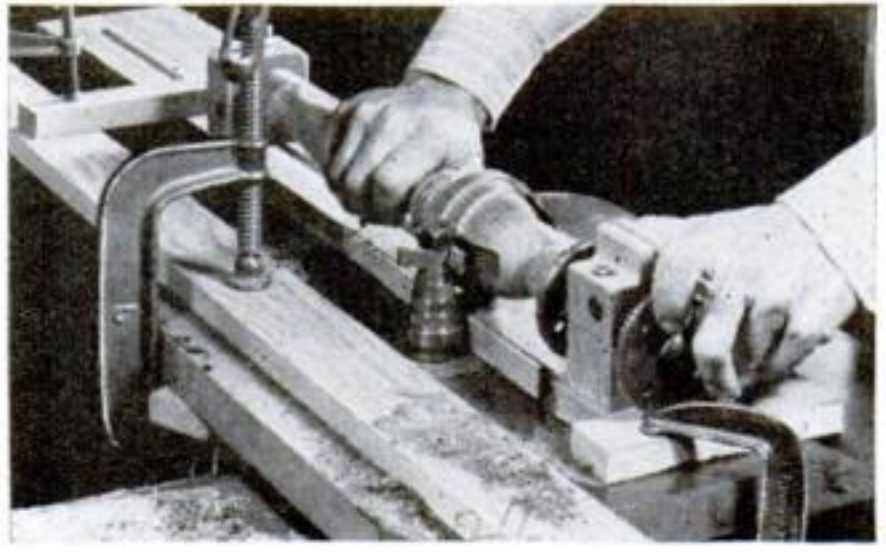
Molding on the edge of a narrow piece is continued on the end with the aid of a horizontal jig fitted with a spline to slide in the shaper-table groove.

In fluting a table leg, as shown below, push the jig against the cutter-spindle collar and slide it on the shaper table until stopped at the other end.



To guide the hacksaw in notching a dividing head for a fluting jig, a strip is clamped to the lathe tool rest. The indexing attachment spaces the cuts.

Below, the fluting jig is being used in grooving a table column to house the ends of tripod legs. It can be used with templates to carve cabriole legs.



quire considerable effort to turn it. Be sure to center the center bolt before tightening its nut and to fit the indexing lever snugly into its slot to prevent play.

To flute or bead a table leg, mount it in the jig, tack on the front edge of the base a guide strip shaped to the profile of the part to be enriched, and mount the turning with its square faces in the proper planes. For each flute, push the jig forward until stopped by the spindle collar, cut by sliding the jig lengthwise until stopped, and then draw the jig back.

Round work is scalloped with the help of a radial arm clamped to the shaper table. The dividing head spaces the cuts, and a stop block regulates depth.

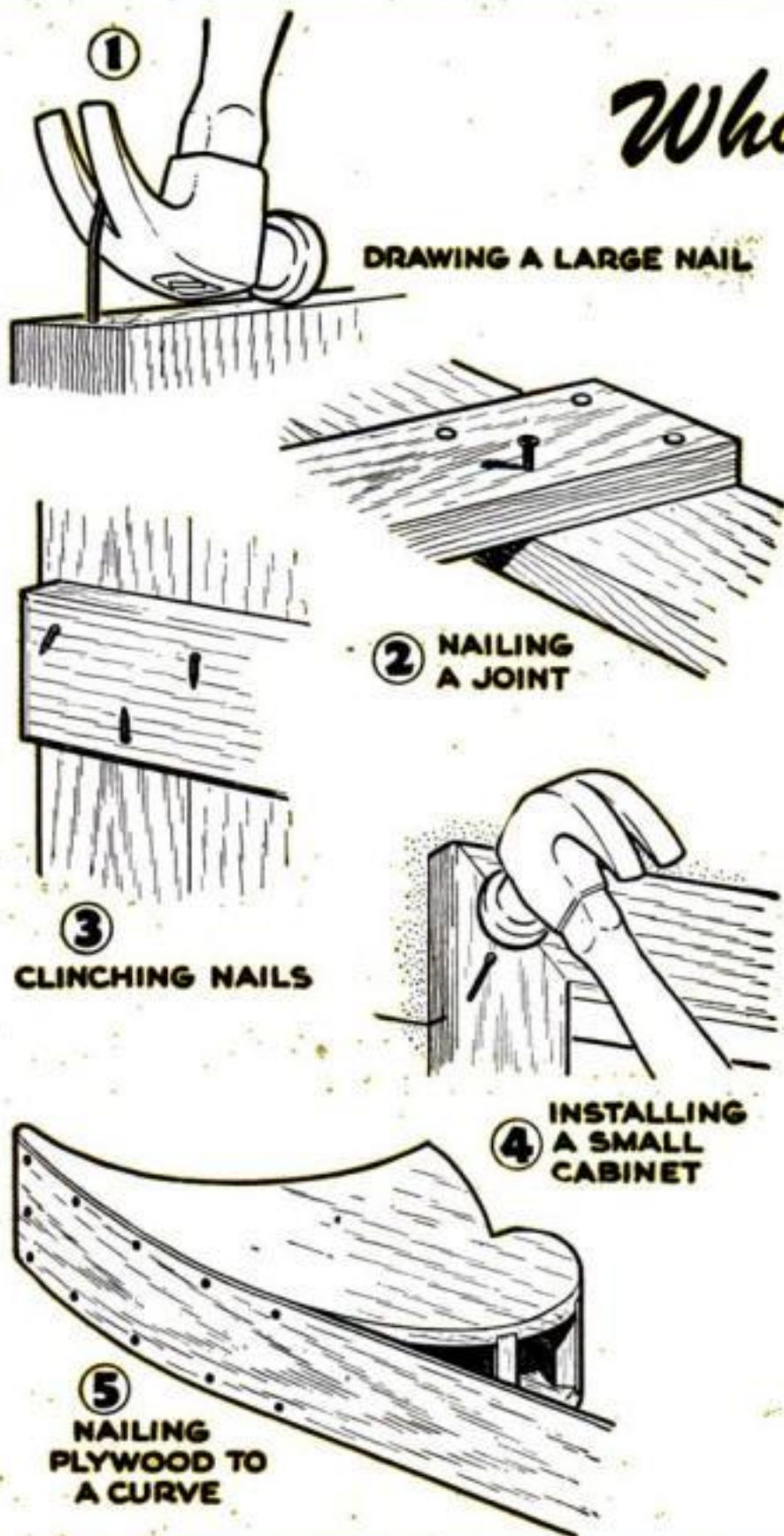


Straight stock can be fashioned into a leg of four or more shaped sides. One template is required for shaping the outer faces of cabriole legs and a second for the inner faces. Inside angles are cut by some other means after shaping.

Of what use is the radial arm? Mounted on the vertical sliding jig and fitted with the dividing head, it is used for carving rosettes. Make a chuck to fit the rosette blank, provide it with a back recess for the dividing head, and attach it with flathead stove bolts. On the vertical face of the jig, clamp a thrust strip on which the inner flange of the dividing head can slide, placing the clamp where it will act as a stop. The radius of the cut is regulated by the position of the bearing bolt in the arm slot, while the angle of the cut with relation to the radius of the rosette is controlled by the height of the bearing on its support. If the cut is made from the center of the rosette, there must be a turned recess there. It can be filled later with a button.

For scalloping a tray, clamp the radius arm to the shaper table. Tack through a mounting block on the dividing head into the back of the tray. Depth of cut is determined by a stop block which the mounting block or the radius arm will strike.

What's Wrong?



FIVE errors in woodworking—some of them much too common—are being made in the drawings at the left. All of them involve nailing; for instance, in Fig. 4 the first nail is being driven to secure a cabinet being set in a cutout between studs and aligned with a mark on the plaster. To test your expertness as a craftsman, see how many errors you can spot; then turn the page upside down and compare your answers with the correct ones given below.

1. A block of wood should be placed under the hammer head to increase the leverage and lessen the chances of breaking the hammer handle.

2. Nails driven into the same grain tend to split the wood. The joint is strengthened by staggering the nails to drive them into different grains.

3. In general, it is good practice to clinch nails parallel to the grain so they can be sunk flush with the surface. Bend the tips over in order to embed them.

4. The nail should be driven at right angles. Inclined as shown, it will draw the work in the direction of the driving.

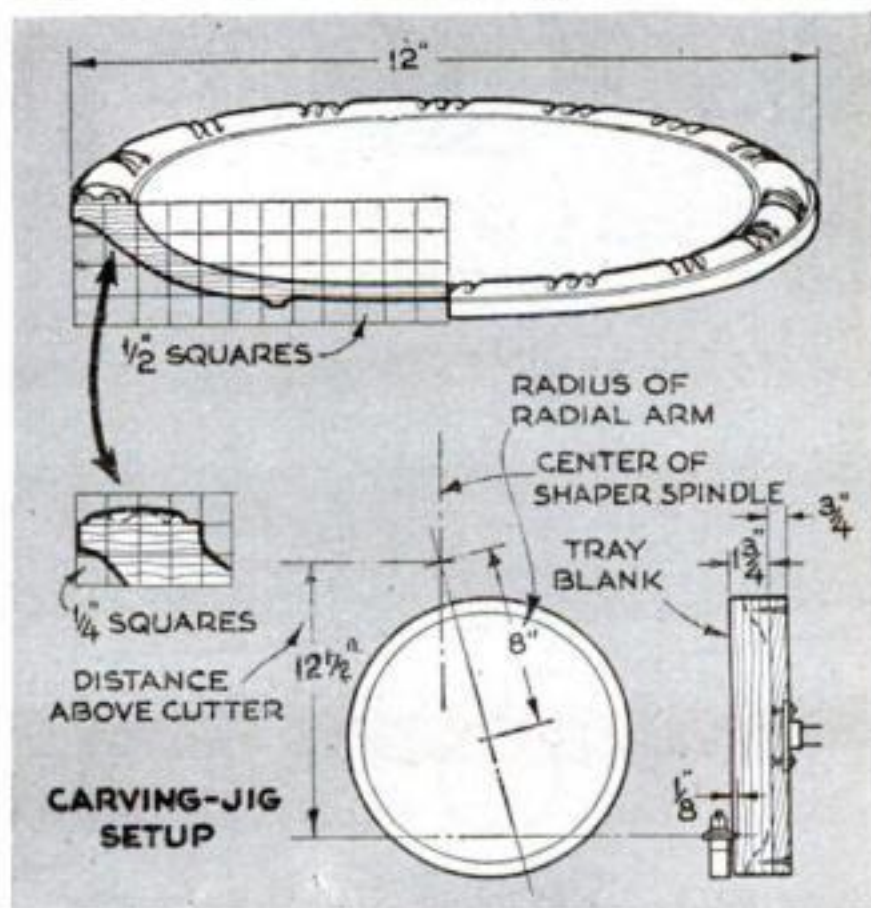
5. Start nailing the strip to the scrolled end. It is easier to handle that way and less likely to break. This also will enable you to cut the strip exactly to length when it is finally in place. It would be difficult to cut off the end that fits into the sharp angle at the end of the scroll.

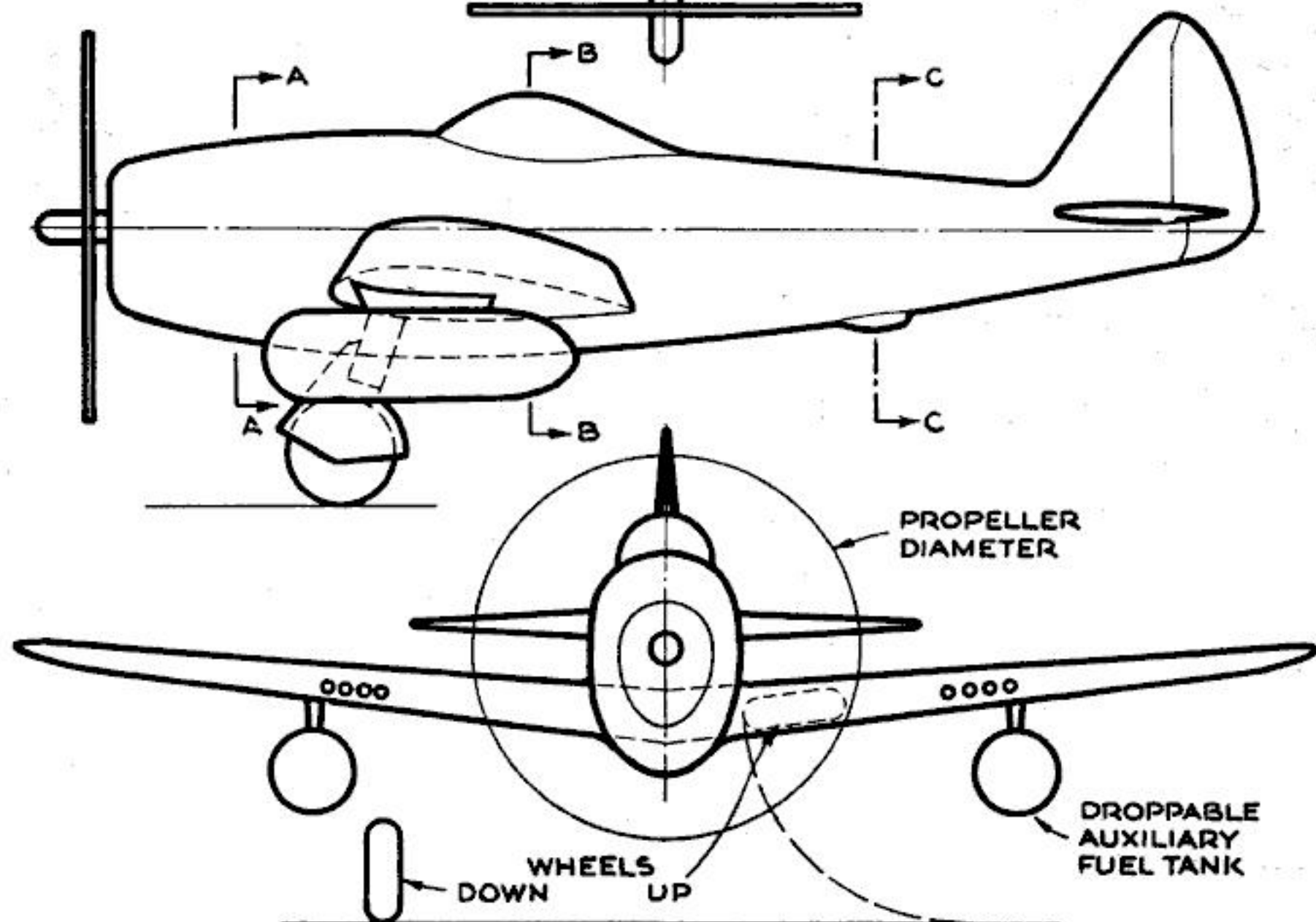
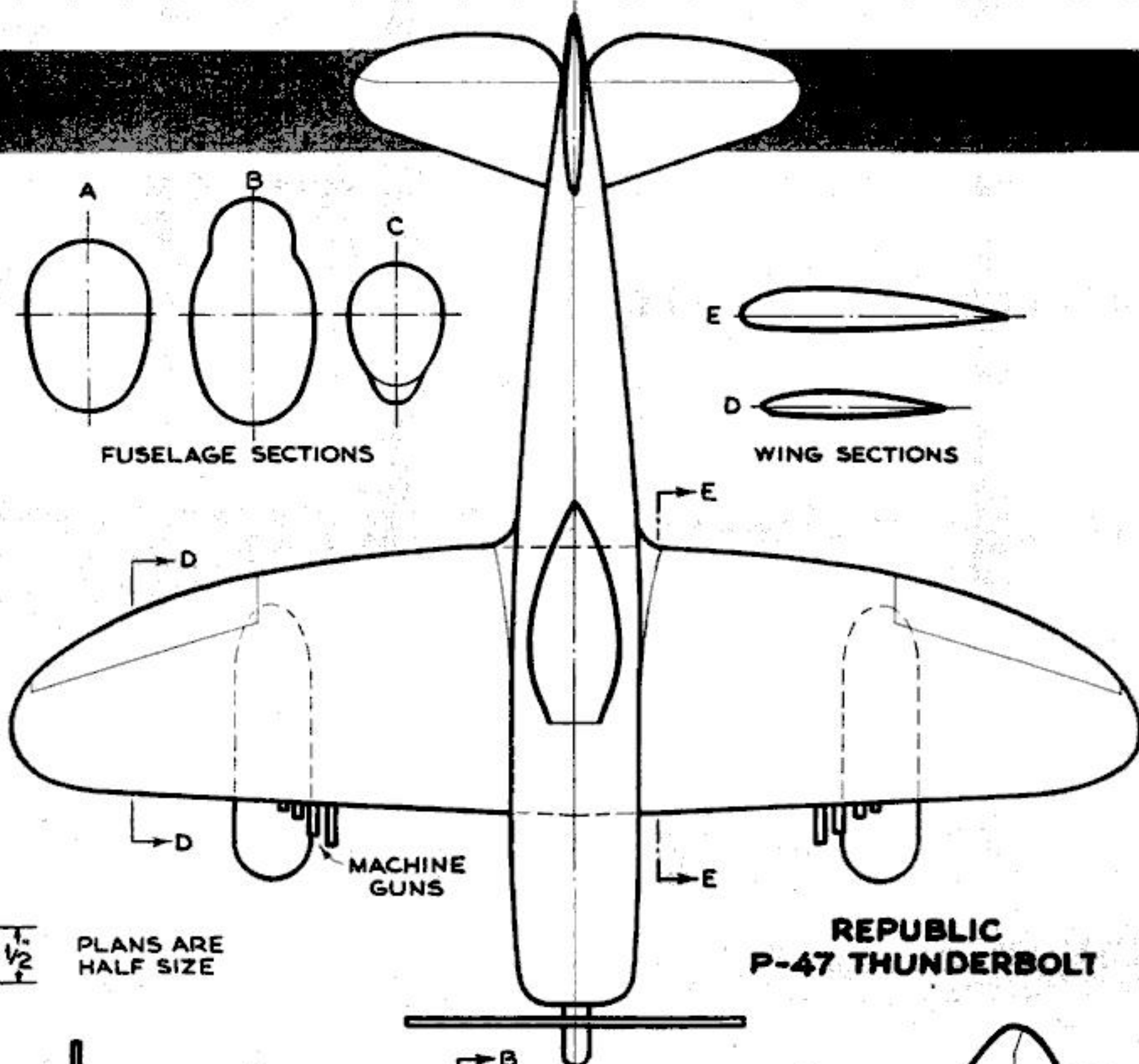
ANSWERS

Rim of Turned Tray Is Enriched by Simple Carving in Shaper

FOR an interesting and serviceable piece that can be decorated in the shaper with the help of jigs shown in the drawings on page 161, turn the tray shown here from a single piece of hardwood $1\frac{3}{4}$ " thick, leaving the bottom unturned for the time being. Recess a backing disk to fit the fluting-jig dividing head, bolt it on, and attach the tray with four screws in the waste. Next, mount the radial arm on the vertical sliding jig as indicated in the diagram at the right.

With a beading cutter on the shaper spindle, make 15 pairs of cuts, leaving a space of one notch on the 60-division flange of the dividing head between each pair. Change the cutter for a $\frac{1}{8}$ " fluting cutter, withdraw the holding screws, twist the blank to center the flute between each pair of cuts, tighten the screws, and finish shaping. Then turn a lathe chuck to hold the top of the tray, and turn the bottom.—E. M. L.





THE THUNDERBOLT IN MINIATURE

FAST, rugged, and heavily gunned, the famous Thunderbolt fighter-bomber is one of the top-ranking American planes. The solid model shown here, made at a scale of $\frac{1}{4}$ " to the foot, is patterned after the latest version which has a new silhouette, 360-deg. visibility for the pilot through an electrically operated bubble canopy, several hundred more horsepower, and increased fuel capacity.

The plans shown at the left are reproduced half size. Connect the $\frac{1}{4}$ " graduations at the edges of the page to form a grid of $\frac{1}{4}$ " squares. Make a full-size working drawing on a large, stiff sheet of paper, laying out a grid of $\frac{1}{2}$ " squares and transferring the lines from the small drawing to the large one by matching squares. Then draw a second, similar full-size layout and cut out the shapes to form full-size patterns.

Use a $1\frac{1}{4}$ " by $1\frac{7}{8}$ " by $8\frac{1}{2}$ " piece of stock for the fuselage. Balsa is ideal material to work with, but pine or some other soft wood may be substituted. Cut the block first to the shape shown in the profile, then to that indicated in the plan view. Carve and sand it until it agrees with the fuselage-section patterns. Make the bubble canopy from scrap material and cement it in position. Cut a slot through the belly, from one side to the other, to take the one-piece wing.

Make the wing from a $\frac{1}{2}$ " by $2\frac{1}{2}$ " by $10\frac{1}{4}$ " blank. Shape it to conform with the top-view outline; then taper it toward the ends to agree with the front elevation, and finally carve and sand it to the form that is indicated by the wing-section patterns. Crack it along the longitudinal centerline so

the tips can be elevated to the proper dihedral. Rest one half flat on the bench, weight it in place, raise the tip of the other half $1\frac{1}{2}$ ", support the raised tip with a block, and cement the cracked center.

The stabilizers and the rudder are fabricated from $\frac{1}{8}$ " stock. Saw them to the profiles shown, taper them slightly toward the tips, and carve and sand them to a streamlined cross section.

Sand each part thoroughly before assembling the model. Use glue or cellulose cement to hold it together. Form the fillets where the after edge of the wing meets the body with plastic composition wood. The two droppable auxiliary fuel tanks and their brackets are next made and secured in place. Cut the propeller disk from celluloid. The stand is bought at a model supply house or made of a turned base and a dowel.

Treat the model with several coats of wood filler, sanding between coats. Paint the entire surface silver with black trim, using a good grade of model-airplane dope. The insignia may be purchased in the form of decalcomanias and transferred to the model.—BILL SPRAGUE.

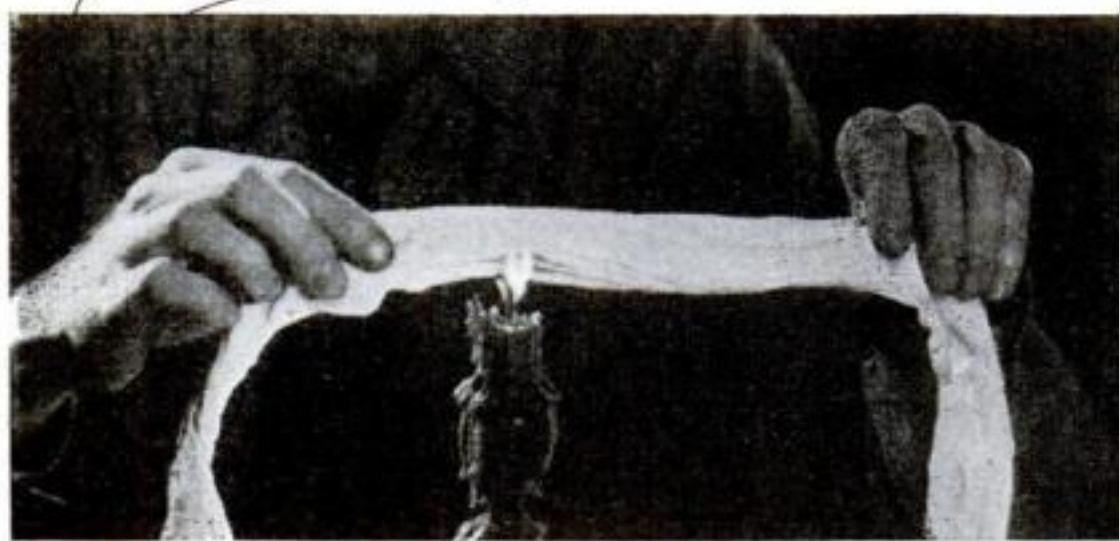
Bomb loads up to a ton in weight are carried by the full-size plane, shown below. It is especially effective for low-altitude bombing and strafing



TOUCH THE TIPS of two pencils held almost at arm's length. Easy, isn't it? Now try it with one eye closed. The result may surprise you! To make the test purely one of vision, drop your arms out of position between each attempt. The reason this simple trick is hard for most people is because we owe our ability to judge depth and distance to the fact that our eyes see an object from slightly different angles. Trained on one object, they act like a range finder.

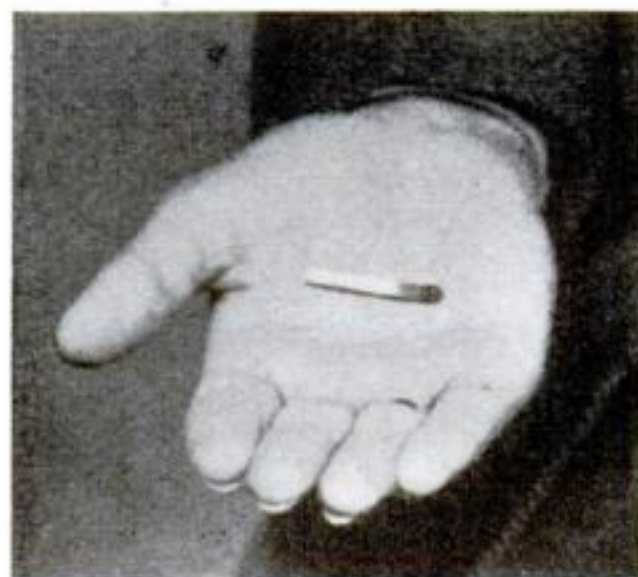


TABLE TRICKS



DRAWING A HANDKERCHIEF THROUGH FLAME is a feat to startle your friends! Roll the cloth tight and, starting at one end, draw it slowly and steadily through a candle or match flame. Don't hesitate, or it may burn. Better still, soak it in borax or alum beforehand.

CLOSE YOUR HAND over a paper match, open it, and the match will seem to have turned end for end—that is, if you have prepared a match beforehand by splitting it and reversing and gluing the halves so a head appears at both ends!



MAGIC ASHES from a paper containing a friend's initials will reproduce those initials on the palm of your hand! Prepare the initials on your hand with soap ahead of time. They won't show. Then burn the paper your friend has written on, and rub the ashes in your palm. They'll stick on the soaped lines.

STEADINESS can be tested amusingly with a paper clip and a small horseshoe magnet. Bend the clip as shown at right, hold it upright on the table with one hand, and bring the magnet near it—not quite to it—with the other. The test is to hold the magnet just close enough for the clip to remain upright when released, but not so close that it will be drawn to the magnet! If your hand is steady, the clip will remain motionless. To make the test really difficult, don't support your elbow on the table when you try it.



French Provincial Armchair

By NORBERT ENGELS

FOR those with an interest in furniture with a historical background, this quaint French Provincial chair should have particular appeal. Its prototype was discovered by my wife and me several years ago on exhibition in the Quebec Public Library, to which it had made its way from the famous Hotel Dieu that was founded by Bishop Laval.

It was not very much later that we had the good fortune to discover a chair which proved to be exactly like it in a near-by junk shop. The chair proved on inspection to be so dilapidated and old, however, that only the arms and one back slat could be salvaged; all the rest had to be rebuilt.

Our original chair was made of birch, maple, and oak—fairly good evidence that it was built of odds and ends by some local and more nearly contemporary worker, not in France as was its aristocratic counterpart from the Hotel Dieu. Its seat was upholstered in leather, and its frame was covered by many coats of dark varnish. We

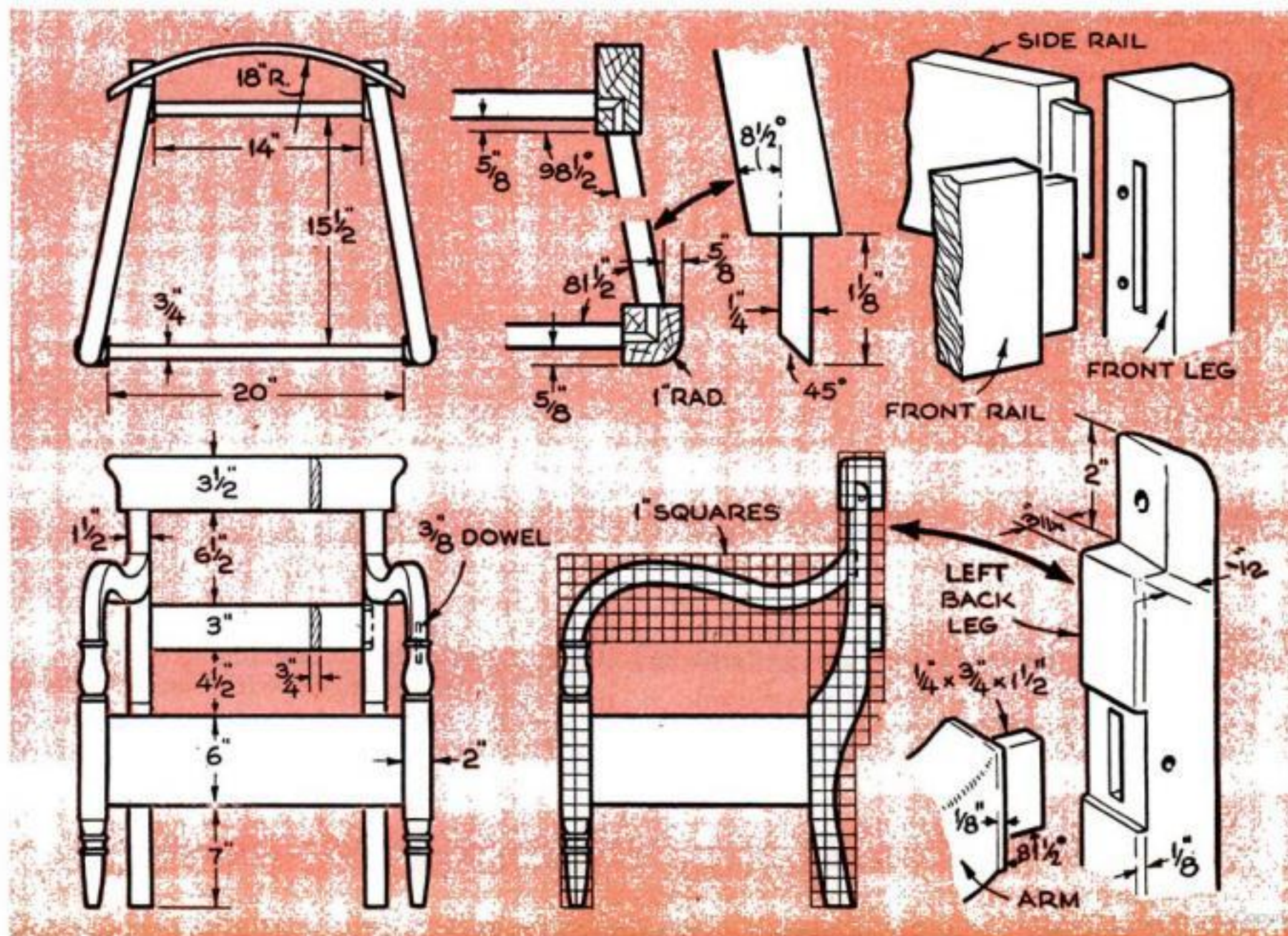


painted our rebuilt chair and a companion piece that we also built in ivory, antiqued it with a slightly brownish cast, added a decal flower design to the top back slat, and put a down cushion on built-in springs. Box springs without the cushion would be just as suitable. Birch or maple is excellent wood for the construction of a new chair.

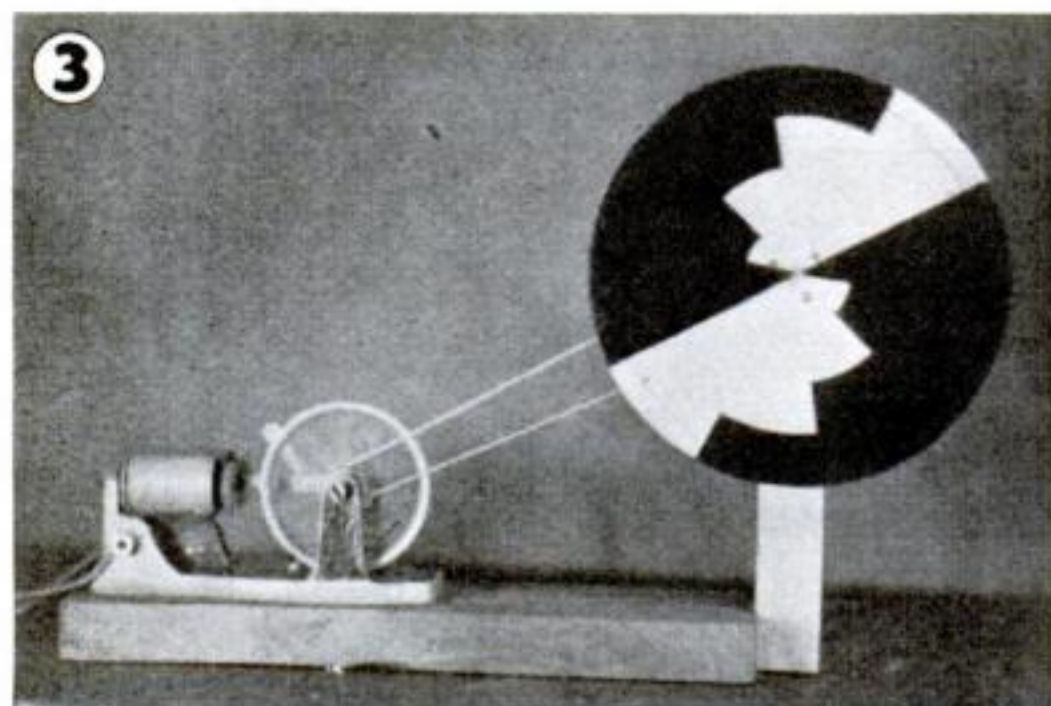
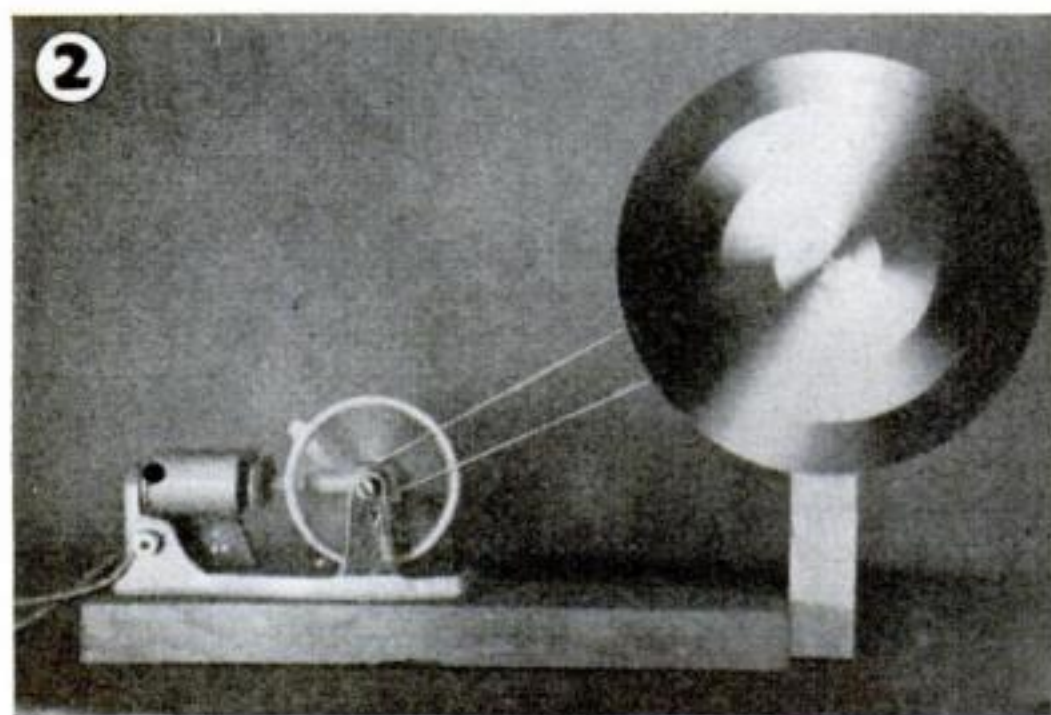
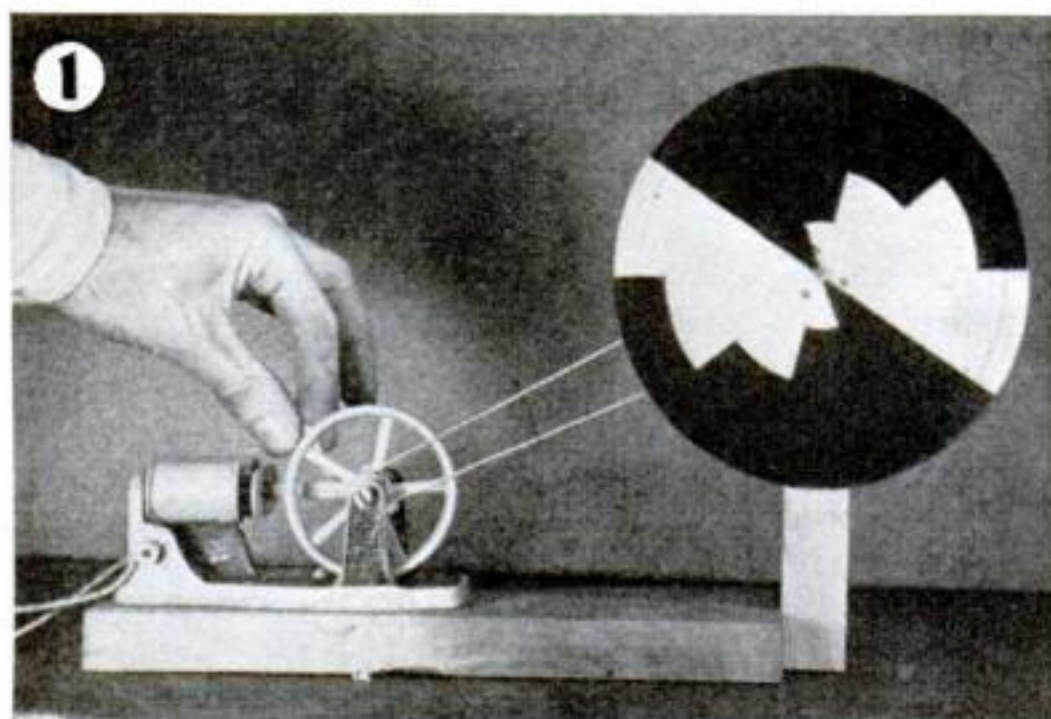
A bandsaw will speed sawing out the shaped profiles of the back posts and

the curved arms and two curved back slats. The only turnings called for are the top and bottom sections of the front legs. Keep the center section square except at the front outer corner which is rounded as shown.

Joints, for the most part, are mortises and tenons locked with $\frac{3}{16}$ " dowels. Note that the tenons of the seat rails meet in the leg mortises and are mitered, and note also the angle the tenons make with the side rails. A screw through each back post holds the top back rail, the screw hole being plugged.



STROBOSCOPE STOPS MOTION



GEARS, automobile wheels, spinning saw blades, and other moving objects can be made to appear to stand still or even to run backwards with the aid of a simple stroboscope consisting of a small electric motor with a slotted disk on its shaft.

Any small universal motor may be used, but it must be connected in series with a

rheostat that will permit smooth regulation of speed at all stages from the slowest to the fastest, for it is on the ability of the stroboscope to match the speed of the object being examined that the success of the device hinges. An ordinary sewing-machine motor and its control were used for the stroboscope shown in the photo at the upper right on the facing page. If you lack such a control, a water rheostat made like that at the bottom of the same page will serve admirably.

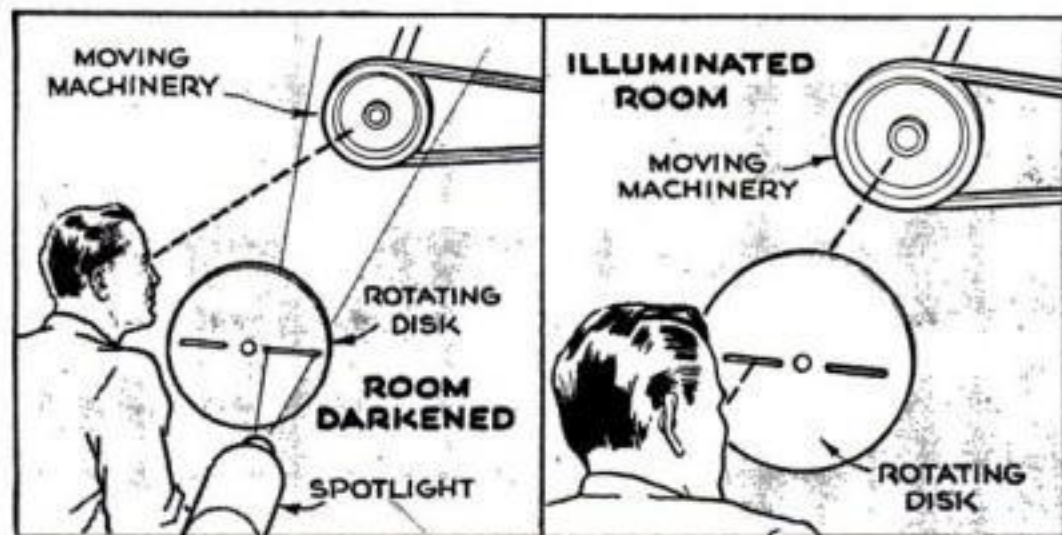
Mount the motor on any convenient stand that will keep the stroboscopic disk from fouling as it revolves. The stand shown has an upright so shaped that it can conveniently be held in one hand when desired.

Cardboard or any light metal may be used for the disk, which should be about 7" in diameter. It is drilled at the center to fit over the motor shaft or a shoulder on the end of an adapter, and is provided with one or more slots. The disk shown has two diametrically opposite slots and works satisfactorily, though one with only one slot proved in comparative tests to give better images and to be easier to control. Bolt the disk to a pulley fitted on the motor shaft or to the face of an adapter if you have a lathe in which to make one.

How the stroboscope stops motion is illustrated at left in the photos of a black-and-white cardboard disk turned by an electric engine. The device is motionless in Fig. 1; in Fig. 2, taken through the stroboscope, the turning disk is blurred but the engine armature is "frozen"; and in Fig. 3 the disk is in synchronism and appears stopped, while the armature is again blurred.

Scores of shop uses will be found for a stroboscope. In one instance, the model shown was used to determine why a tiny sanding drum operated at 15,000 r.p.m. by a small hand grinder caused considerable vibration. Adjustment of the stroboscope speed to make the drum appear to revolve slowly in one direction and then in the other revealed that the shaft was slightly bent, for the end of it described a circular path in-

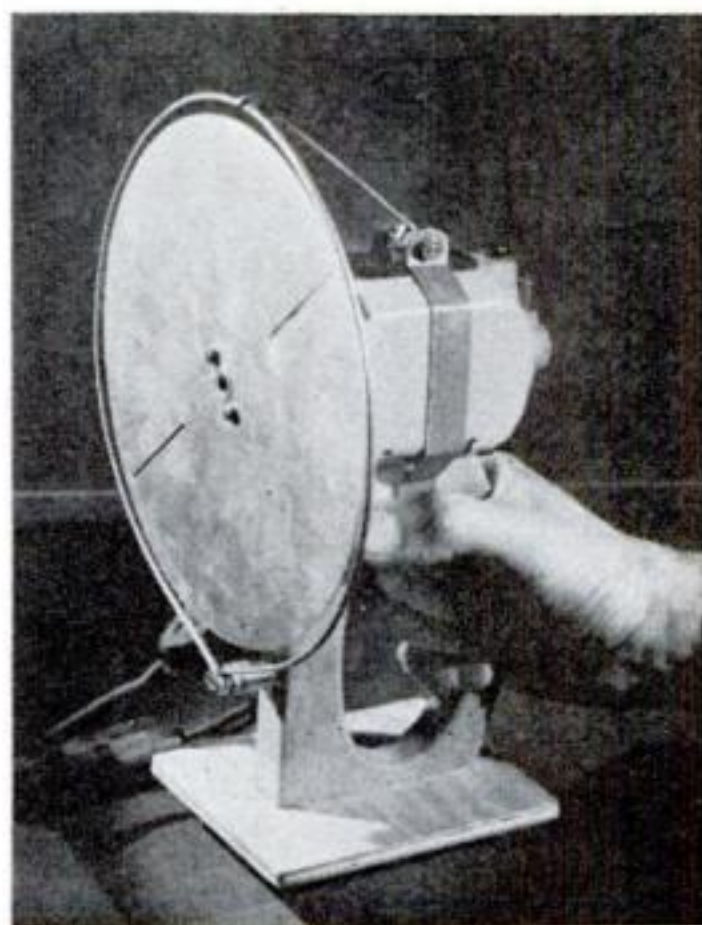
OF SPEEDING MACHINERY



stead of running dead true.

In another case, a movie projector seemed noisy, so the beam of a spotlight was turned on its film-feeding mechanism through the stroboscope. Adjustment of the stroboscope speed to make the feed fingers or shuttles appear to be traveling slowly revealed that the outside shuttle oscillated sidewise. When the projector was stopped, it was found that there was considerable

Two methods of using a stroboscope are shown above. Both appear to halt motion when speeds of the stroboscope and object are synchronized. The disk at the right is encased in a wire guard



play in the cam operating this shuttle. Jigsaw blades, shop V-belts, and other moving equipment may be checked in the same way.—ERVIN WALTERS.

Water Rheostat Built in Jar Controls Speed of Small Motor

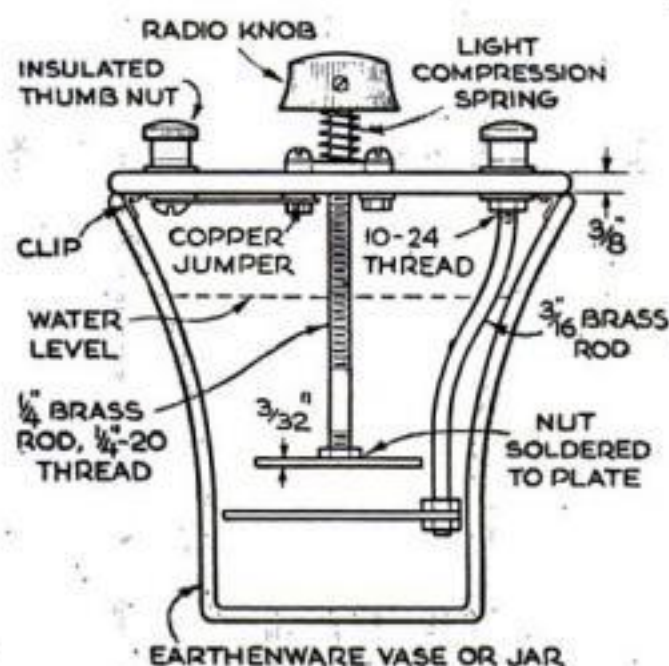
ONE of the easiest and most satisfactory methods of regulating the speed of a small universal motor is with a water rheostat. That shown in the photos and drawing below was made from odds and ends. The container for the water may be any small earthenware or china vase or jar with a relatively large mouth—about 4" deep and 5" in diameter at the opening is suitable for the stroboscope motor shown above. It should

be provided with a round hardwood cover.

Adjustment is provided by screwing the smaller plate up or down, thus regulating the water resistance between the two plates. The closer the plates are, the higher the motor speed will be. A pinch of table salt in the water may be needed.

On long stretches, the water may get hot; but for 15 minutes or so temperature will remain moderate.—HAROLD P. STRAND.

Connected in series with a small universal motor, a simple water rheostat made like the one shown below will regulate speed easily and smoothly by furnishing a variable resistance between the two metal plates





Meet

WALTER E. BURTON

WHERE do contributors get their ideas? Walter E. Burton, who is one of **POPULAR SCIENCE**'s most prolific, isn't always sure, but he remembers how "Seven Steps in Restoring Old Scissors" came into being. Helping to

clean out the garage of a neighbor, he came across a rusty old pair. On offering them to the neighbor, he was told to throw them away. Instead, he took them home, thinking he could fix them up for use in the darkroom. In the midst of the repair job, it struck him that other people might have old scissors they would like to salvage, so he got out his camera and photographed some of the steps as he went along. The scissors, however, never reached his darkroom—they cut so well after being rebuilt that they were commandeered by his sister for her sewing basket.

Burton has been a writer almost all his life. Born at McMechen, W. Va., about the time the Panama Canal and the Wrights' plane were built, he moved to Kenmore, near Akron, Ohio, when he was six, and sold his first magazine article while in high school. Since then he has acquired a college education at Johns Hopkins in Baltimore, Md., and has been a newspaper reporter in Akron, where he now makes his home. He quit newspapers because he didn't like regular hours, and he has been free-lancing ever since, writing features, how-to-do-it articles, a little fiction, and half a dozen books. His features cover many subjects, from airplanes to zoos, while his how-to-do-it articles are chiefly on wood and metal projects, photography, and microscopy.

At the left, Burton is shown in his shop, tinkering with a lathe measuring dial he invented and on which a patent is pending.

Seven Steps in Restoring Old Scissors

By **WALTER E. BURTON**

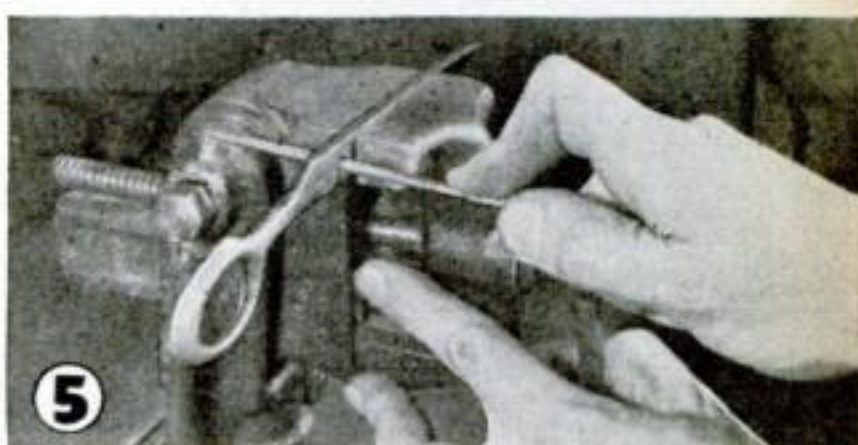
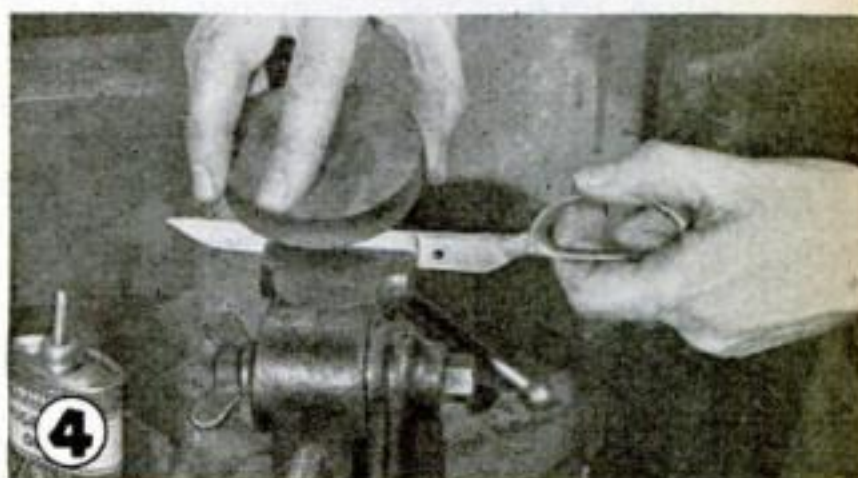
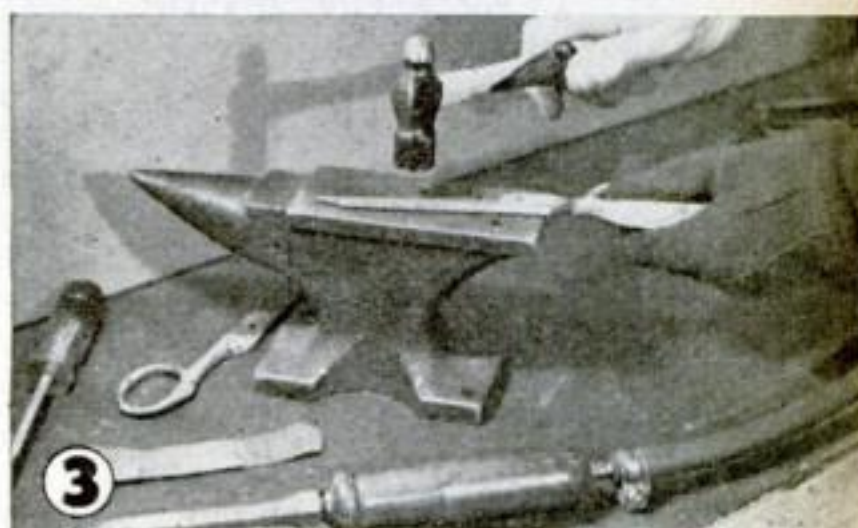
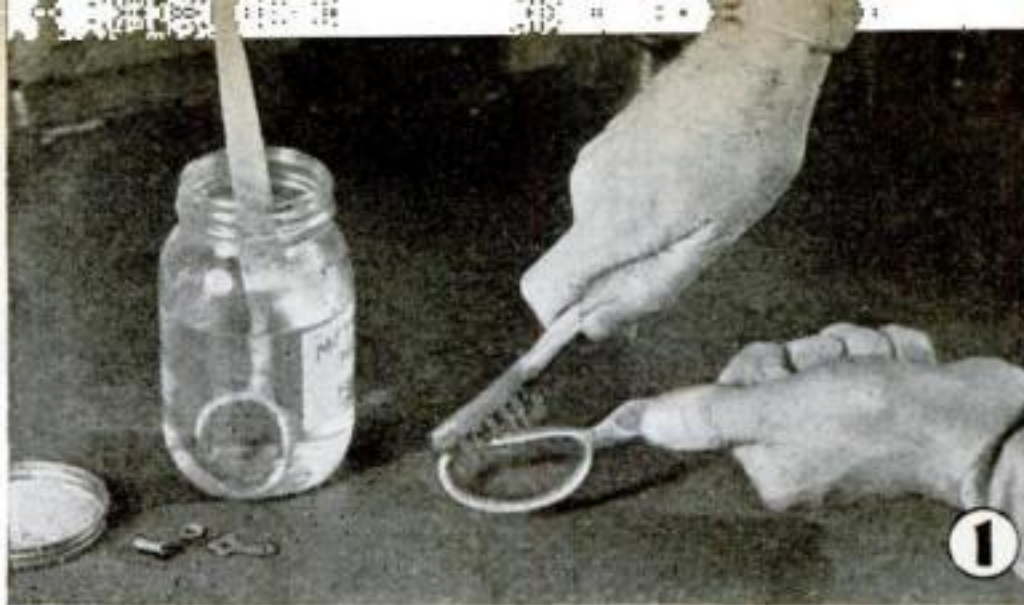
RUST and badly worn blades have consigned many pairs of scissors to the junk barrel. The scissors shown in the accompanying photos had, in addition, overlapping tips resulting from wear in the rivet holes, and one of the blades was bent. Yet, with a little judicious rescue work, they were restored to their former usefulness—really a simple task that may help you put discarded scissors in your home back into service.

The first step is to separate the blades by removing the rivet or bolt that holds them, and then to clean off every trace of rust and old paint, as in Fig. 1. A rust-removing solution of the type used in automobile paint shops and a wire brush are efficient.

Next, polish the blades throughout with

abrasive cloth (Fig. 2) until they regain most of their original luster. A drop or two of oil will help produce a fine polish. If a blade is bent, polish one surface of that blade first until it is bright; then heat it gently and evenly with a torch or over a gas-stove burner until the bright area begins to show a yellowish or light-bronze tinge. Take it to an anvil, lay it with the concave side of the bend down, and hammer lightly to flatten it, as shown in Fig. 3. If it is not straight after no more than a dozen blows, repolish and reheat it before further hammering. Such moderate heating (450 to 500 deg. F.) reduces the likelihood of cracking the metal without affecting its hardness.

The cutting edges of old scissors are usually dull, irregular, and worn from frequent sharpening. Use an oilstone (Fig. 4)



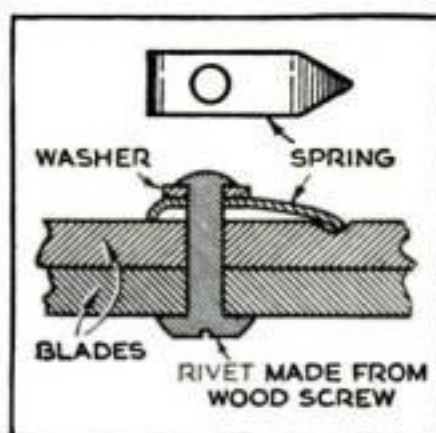
to even them up and give them a keen edge. The honed surface should slope slightly. Also hone the inner surfaces of the blades, which are often hollow-ground, to remove rough spots and burrs.

Make a trial assembly of the blades to see whether the tips are even when closed. Usually they will overlap, especially if the screw or rivet holes are worn. In this case, shift the rivet holes slightly by filing with a rattail file toward the cutting edge as in Fig. 5; then redrill them for a larger rivet. If the tips fail to come together, shift the rivet holes in the other direction by filing toward the back of the blades, and redrill as before.

A new rivet can be made from the unthreaded portion of a roundhead wood screw. File the head to flatten it and, if necessary, file the shank while rotating it in a drill-press or lathe chuck for a uniform diameter and a snug fit. Assemble the blades with the rivet, a spring, and a nut or washer, and head the end of the rivet with a hammer, as shown in Fig. 6. A bolt and nut may be used, but if the bolt is threaded all the way to the head, it may wear rapidly. Secure the nut by riveting the end of the bolt lightly.

The drawing below shows a scissors joint with a rivet made from a roundhead wood screw. A flat spring keeps the blades together even if they are bent slightly or if the joint is worn, and it provides a desirable resiliency. If an original spring is lost, one can be made from a heavy clock spring or a phonograph-motor spring after first heating the metal to redness and letting it cool to soften it. After shaping and drilling the spring, reheat it to a cherry red, quench it in water, and temper by reheating to a uniform dark blue. A one or two-turn coil spring or a split washer may be used instead.

Finish the job by repainting the handles, as in Fig. 7, with any good enamel or lacquer. Bake-on enamel is excellent if you have it and the facilities for heating it. Wrinkle or crackle enamel, however, should be avoided, for such a finish is uncomfortable for the user whenever prolonged cutting jobs have to be done. A drop of oil between the blades at the rivet or bolt makes them work easier.



Does Your Boat Winter

SHIPSHAPE POINTERS FOR SNUGGING DOWN YOUR VESSEL

By ELON JESSUP

RAIN, snow, ice, and sun can do irreparable damage to an improperly laid-up boat during the winter months. One authority estimates that an adequately protected boat will last three times as long as one that is habitually neglected. Another points to rewards more immediate—he claims that your spring-outfitting time can be cut in half, and that a corresponding reduction in the amount of paint and the extent of repairs necessary can be realized, if you will but take a little care in laying up your boat.

All smaller craft, such as rowboats, open sailboats, runabouts, and thinly planked outboards, should be stored under cover in an unheated, well-ventilated, dry place, such as a barn, a shed, an unheated garage, or a covered porch. A steam-heated room or a damp, moldy cellar will quickly ruin a hull—heat dries out the planking to a harmful degree and dampness encourages dry rot.

It is advisable to rest the boat on a pair of sawhorses, on staging, or on the roof beams. Some owners suspend their boats from the rafters with blocks and falls. All such means of raising a boat above the ground or the floor serve to keep it away from dampness and to allow air to circulate freely about it.

Larger boats should also be stored inside, if a large enough building is available for

the purpose. In the absence of such a structure, they may be stored outdoors, either in the water or on dry land. But no matter whether they be afloat or ashore, they should have winter covers to protect them from the elements. If rain and snow are allowed to collect on the decks, the seams will fill with water, which will freeze and force the decks to open up. If water gets in the bilges and is allowed to collect in stagnant pools, it may encourage and nurture dry rot. Sun can ruin paint and cause wood to crack and warp. So boats should be shielded from the ravages of capricious winter weather.

Canvas—a good 10-oz. duck—is the best and most durable winter-cover material. You may buy it either treated or plain—both types are satisfactory. If it is treated, it will be waterproof, or at least water resistant. If it is plain, don't attempt to waterproof it yourself. This warning is given because most home-waterproofing methods depend upon paraffin or oil to seal the pores in the cloth. Both paraffin and oil may contain a certain amount of residual acid, which will attack the cotton in the canvas and cause it to rot and crack, especially in the creases.

If you can't get canvas, roofing paper will do. Either material should be laid over a wooden framework. Simply to throw a cover over a boat without a frame is useless because pockets will form and fill with water, which will slowly seep through the material to the boat, where it may cause great damage, as described above.



in the North?

DURING THE OFF SEASON



A typical frame consists of a 2" by 4" ridgepole, which runs the length of the boat and is mitered fore and aft to meet the stem and the stern; a series of 1" by 2" rafters, which slope from the ridgepole to the edges of the deck; and several uprights, which support the ridgepole. The frame should have a fairly high peak so there will be enough pitch to shed rain and snow easily.

Figure 1 shows a nearly completed frame. Here the outboard ends of the rafters are braced against the rails. An upright goes to the cockpit flooring. The mast serves as another. Despite the obvious convenience of so using the mast, it is better practice to take all the spars ashore and store them under cover, in which case a short upright between the cabin top and the ridgepole should be substituted in place of the mast.

The canvas in a cover does not necessarily have to be new, nor need it be in a single piece. It can be laid on in sections, like roofing paper. Incidentally, if roofing paper is used, run it athwartships from gunwale to gunwale, not fore and aft. In Fig. 2, a canvas cover is being spread. Avoid leaving any sagging pockets that might catch and hold water. Lash the cover tightly about the mast, as in Fig. 3, to keep rain water out. Fasten it firmly in place so it can withstand the best efforts of a winter gale to rip it off. If the boat is stored ashore, rope lashings running under the bottom will serve. Usually, however, nails and wooden lathing are used. Figure 4 shows such lathing being ap-

plied to the rafters. Some boatmen hesitate to make nail holes in the center of a good canvas cover, and rightly so. It may not be necessary to do this if the cover is all in one piece and firmly fastened to the boat, just below the gunwale, with a line of laths. But if the cover is put on in sections or if it is old, it may be ripped off by the wind unless it is secured by laths that are nailed to the rafters and to the ridgepole.

Provide some means of entrance and exit. Figure 5 shows a trap door, like a tent flap, that is convenient when you want to get aboard to bail the hull out or to do any of the winter repair and replacement jobs that are on every boatman's agenda. Use very thin galvanized nails to fasten the cover to the boat. Such nails won't seriously mar the hull. If you have plenty of canvas to spare, let it drop below the gunwale to protect the sides of the boat. Exceptions to this are boats that depend upon portholes and scupper holes for ventilation. Don't cover such openings.

Ventilation is of supreme importance in a covered boat since dry rot cannot flourish in a well-ventilated spot. Usually old canvas that has never been waterproofed is porous enough so no other means of ventilation need be employed. When you use a processed canvas or roofing paper, however, vents become essential. If the boat has portholes, leave them partially open. If it has scupper holes, remember not to cover them. Tiny dormer vents may be set in the cover, as in



2

Fig. 6. About a half a dozen each side of the boat are sufficient. Lacking all these means of ventilation, the cover may be left partially open at the stern. Try to keep the elements out, but even if a little rain and snow do drive in, they'll prove less harmful to the boat than would a complete absence of ventilation.

Wet storage, or mooring a boat in the water all winter, is probably the easiest and the cheapest way to lay up and some experts consider it to be the best for the boat. They don't like the alternate swelling and shrinking to which a boat that is hauled out is subjected—soaking up water and swelling when afloat and drying out and shrinking when ashore. They prefer to allow the boat to soak up all the water that the hull will hold when it is first launched and thereafter to leave it permanently in the water, except when it becomes necessary to haul to renew the bottom paint or make occasional repairs. Another thing they don't like is the prospect of damage caused by improper handling and shoring, which might result in a permanently warped hull.

But it is granted that there are numerous localities where the wet-storage method doesn't work. For instance, it is essential to haul rather than leave a boat in a northern fresh-water lake where irreparable damage would be caused by the thick winter ice.

Salt water is different. There are countless well-protected small basins along our northern coasts where a boat can safely ride out a winter afloat, despite the presence of a certain amount of ice. But even salt-water ice must be guarded against. Thin sheets of window-pane ice look harmless, but can cut into a hull like a sharp knife, and any sort of moving ice is even more dangerous.

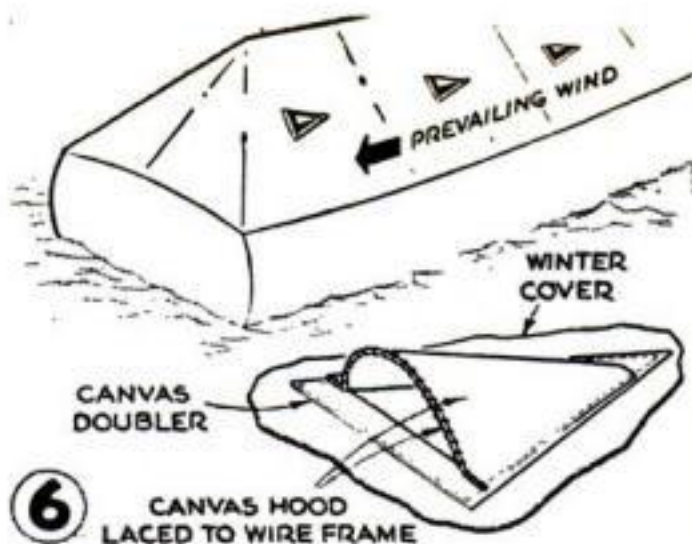
Protection is simple. It entails putting ice buffers around the hull in the area of the waterline. Once upon a time old tires were used for this purpose, as in Fig. 7. Now you will probably find that rope or logs are easier to obtain. If you use rope, festoon it about the hull in such a manner that the waterline and an area either side of the waterline for a distance of about a foot up and down are guarded. If you use logs, float them alongside the boat and temporarily secure them to the hull.

Figure 8 shows a group of boats that are safely moored for the winter in a protected salt-water basin. Their winter covers are in place. All that remains to be done is to add ice buffers around the waterlines.

If you decide to haul your boat, rather than leave it in the water, be sure to provide adequate support for it. Three calamities can descend on a boat that isn't well shored up and blocked. First, a winter gale can knock it over. Second, the hull can hog out of



shape—droop at the bow and stern—if the supports are insufficient at the ends of the boat. Third, the hull can sag—settle amidships—if the shoring is inadequate along the mid-length. The boat should sit solidly on her keel and be braced so strains are distributed over a wide area, with no undue amount on the keel, the frames, or the planking. Ground in winter, because of alternate freezes and thaws, is an unreliable foundation; so lay long planks to take the lower ends of the shores, otherwise they may sink and leave the boat unsupported.



Hauled-Out Boats Require Winter Covers and Adequate Shoring



Left: a well-protected motorboat. The winter house has a wood frame over which is applied a roofing-paper cover. The house is made wider than the hull to allow adequate ventilation. The shores and braces here are exceptionally good, since the boat is supported at numerous places, including very near the bow and stern



Right: a stern view of the same boat showing the after supports and the winter house. Note that a big access door is let into the house to facilitate getting aboard for inspections

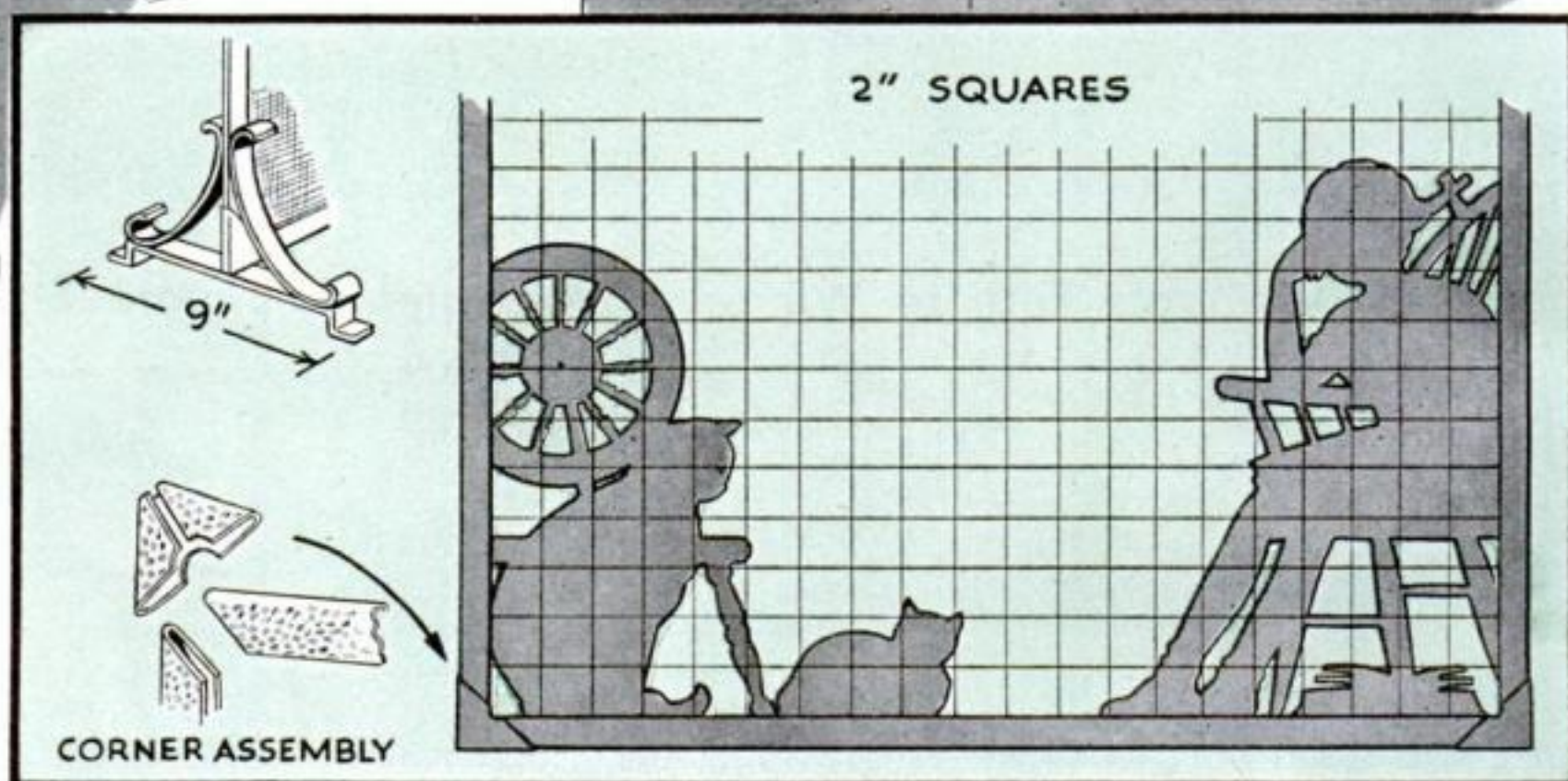
Despite the winter cover, a certain amount of water will find its way inside. If the boat is in wet storage, go aboard at regular intervals and pump her out. If she is wintering on dry land, bore a hole through the lowest part of the bottom to allow such water to drain off. Be sure to remember to plug the hole before launching time.

Your engine requires particular attention. Drain off all the gasoline and water. Remove the spark plugs, pour several ounces of lubricating oil into each cylinder, replace the plugs, and turn the motor over by hand

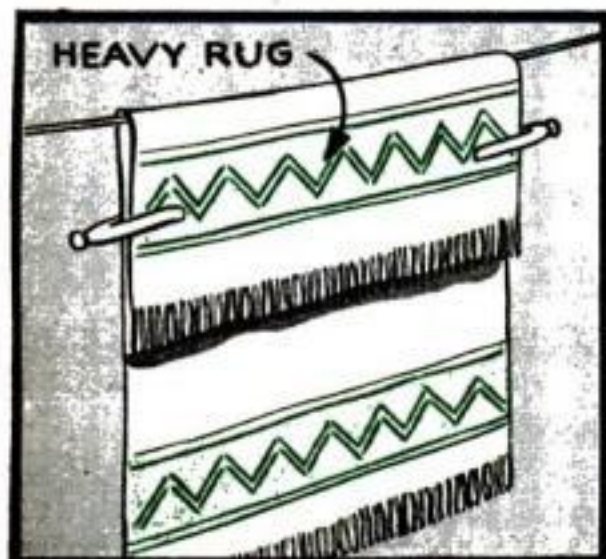
a few times to distribute the oil. Drain the crankcase, flush it out with kerosene, and pack it with waterproof grease. Scrub the outside of the engine to remove all dirt and grease; then cover the bright parts with petroleum jelly and the iron parts with grease to protect them from the damp air.

Take all bedclothes, curtains, cushions, and lines ashore and store them in a locker. Stack the mattresses and cushions on edge and hang the lines up. Mattresses and cushions laid flat, one on top of another, and lines coiled on the floor are apt to rot.

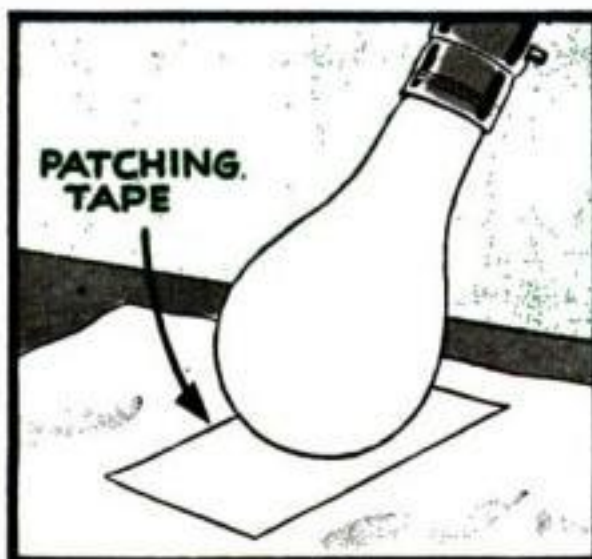
KEEPING



Silhouettes cut from black sheet iron, or even from unsalvageable tin-can stock, and riveted to the edge of a fireplace screen, make interesting designs. Lay out the figures on squares and transfer them to the stock. Those shown are for a large screen, but they can be reduced easily. If you have no suitable screen, one can be built of strap iron riveted together and capped at the corners with the same stock as is used for the silhouette. Be sure to use only heat-resistant enamel if the cutouts need painting



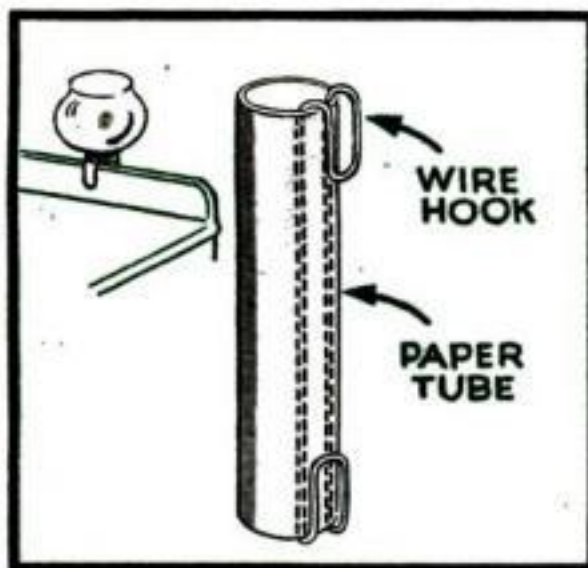
When a rug or other heavy article is hung on a clothesline, putting the clothespins on below the line will keep them from being split



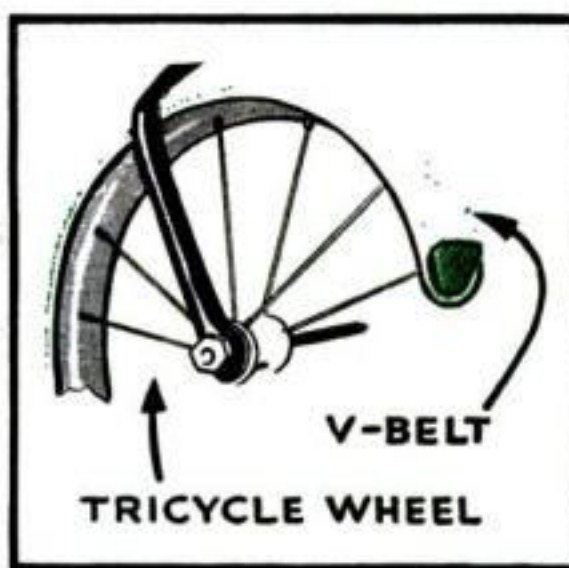
Mending tape of the kind used to patch clothing may be pressed on with a hot 75 or 100-watt bulb if an electric iron isn't available



Mix water and a cup of laundry starch into paste and thin with 6 oz. glycerin to make a nonslip backing for a medium-sized rug



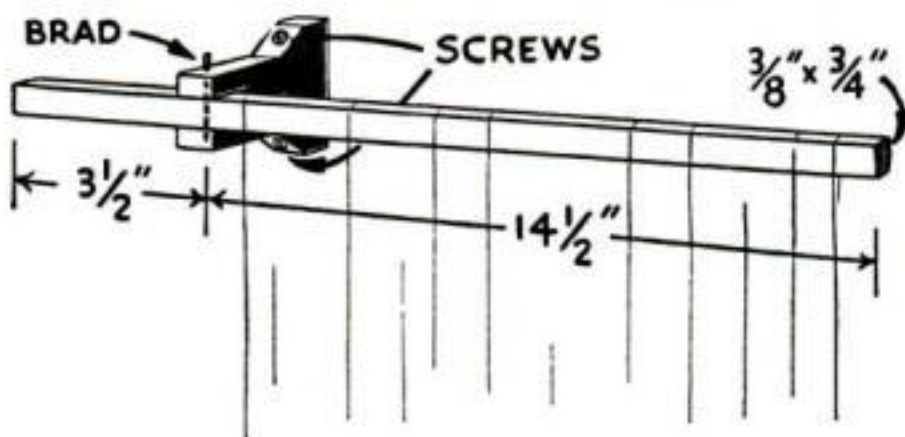
Hooked on the back of a range, as shown, a mailing tube will hold the upper bowl of a glass coffee maker. Cloth stuffed in the bottom absorbs moisture



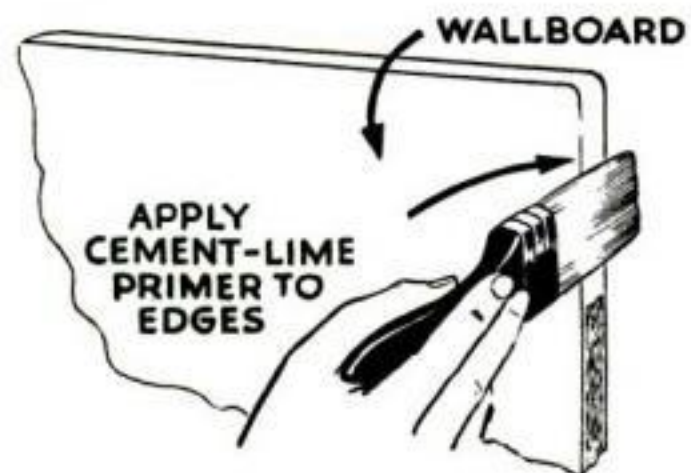
If you can't replace a tricycle tire, use a V-belt made for an auto fan. It should be 1" less in circumference than the wheel and stretched on over the rim



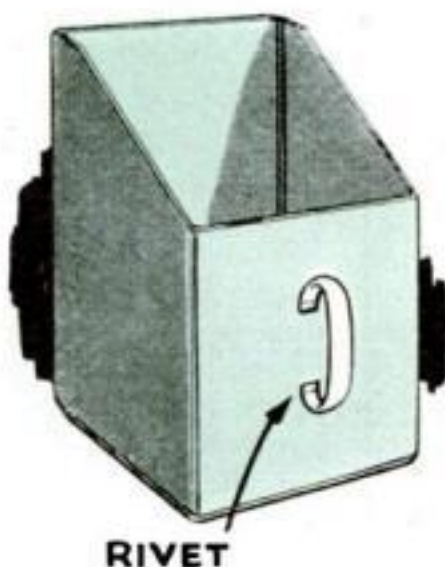
Stray dogs and cats can't get into milk if the bottles are held down by the ends sawed from a discarded paper-towel holder. Arrange the arms to drop flat when not in use



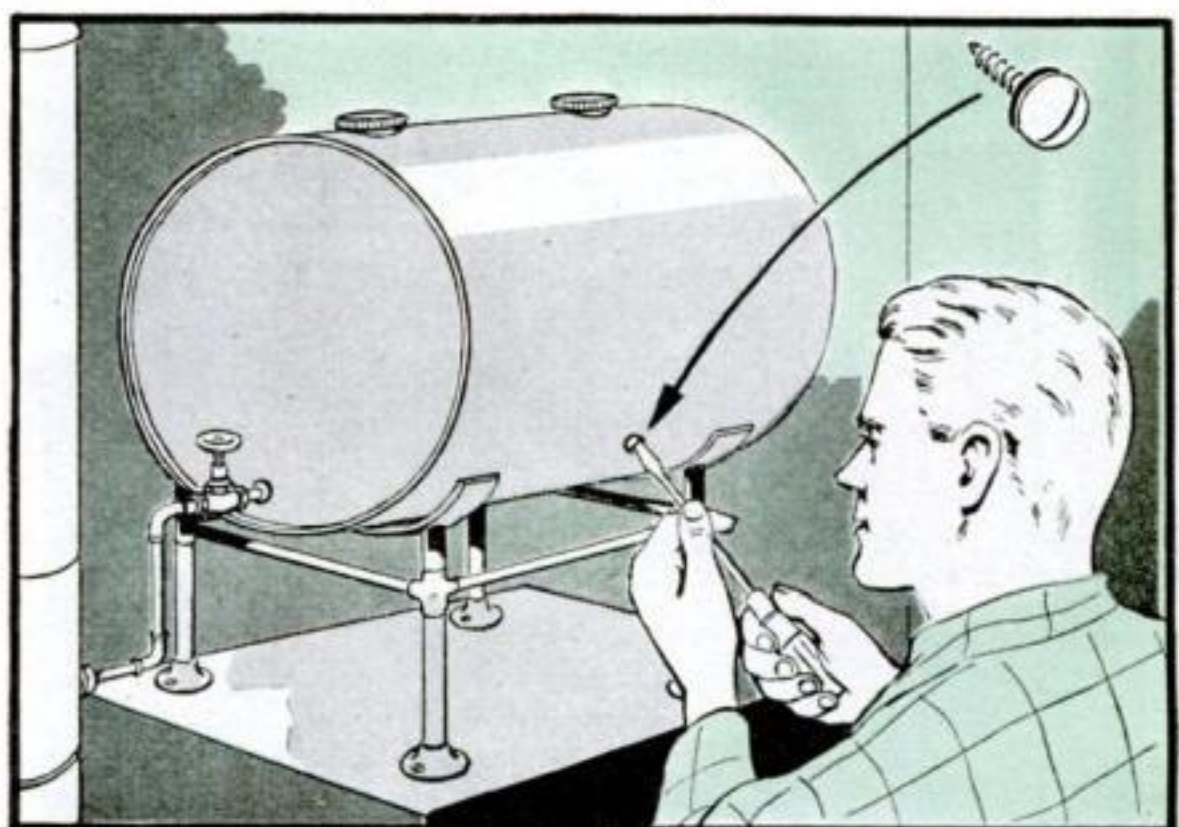
Side curtains hung on a pair of rods made up of hardwood to the dimensions shown and installed at the edges of a narrow window will make the space appear larger. Have the short ends on the inside



Edges of soft-type wallboard, used unframed and unpainted for screens, table pads, and the like, can be protected by a coat of cement-lime primer. After the primer dries, smooth it with sandpaper



Cut from a square 5-gal. can, as shown, and equipped with a handle made from the leftover stock, the handy dustpan above is also a wastebasket. Turn and hammer down all edges, and paint and decorate to match a kitchen or other color scheme



Pinhole leaks in a tank can often be plugged up satisfactorily with small self-tapping screws, as shown below. For a tight seal, use a leather washer or a piece of rubber as a gasket under the screw head

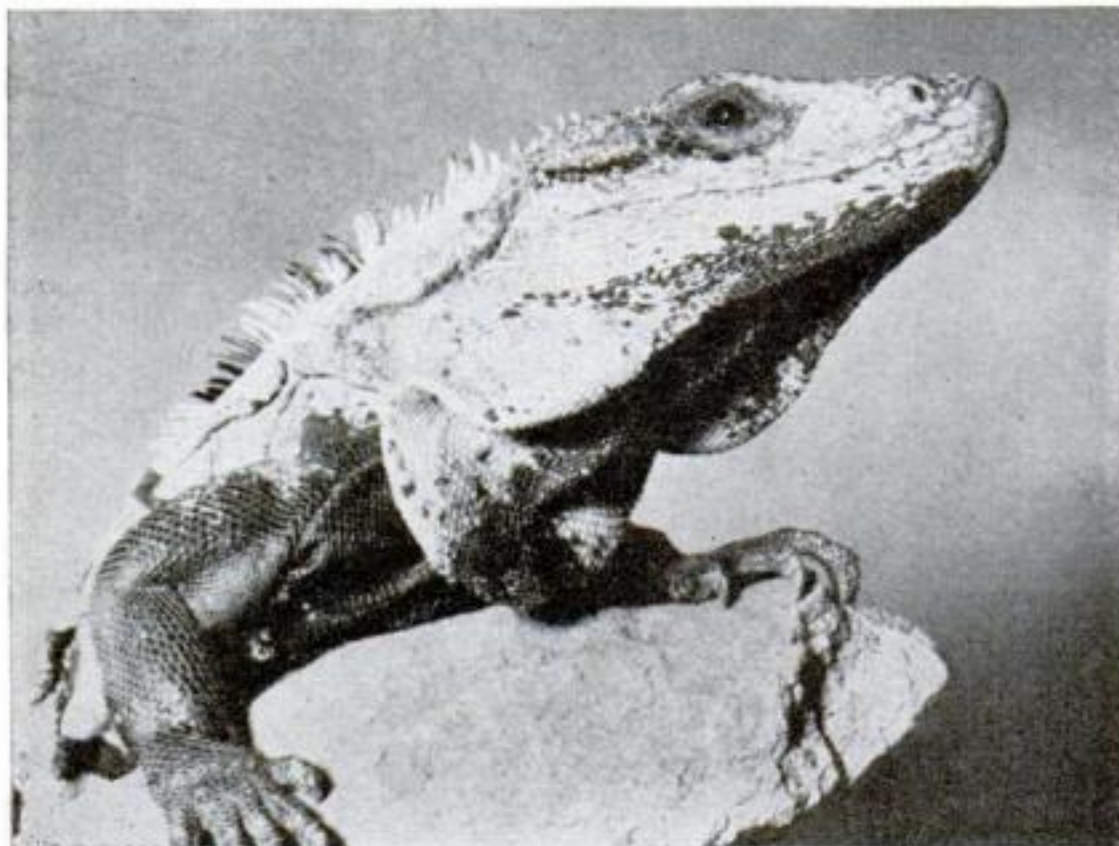
Who's Afraid?

SOME ANIMALS POSE FOR PHOTOS LIKE SEASONED CELEBRITIES; OTHERS SHRINK AND SNARL AT THE GLARE OF THE FLASH BULB

NATIVE ferocity doesn't always make an animal brave when it faces a camera; neither does timidity necessarily cause another to shrink. That's the experience of Isabelle Kauffeld, noted zoo photographer,

who took these pictures of familiar and strange creatures at the Philadelphia Zoo.

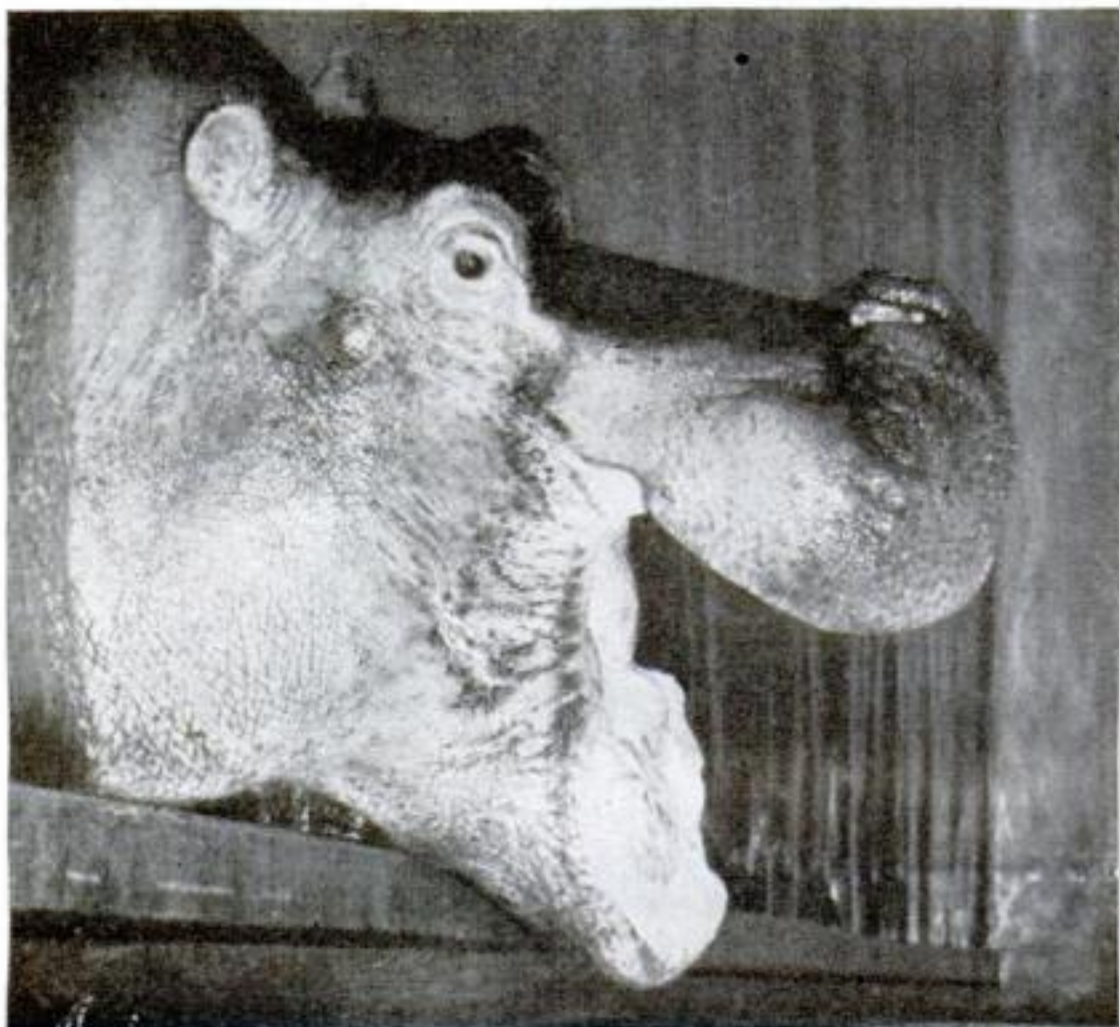
Most animals expect a flash bulb to accompany the black box pointed at them, and some of the most formidable become terrified even before the photographer has finished setting up his camera. Others go about nonchalantly with no discernible reaction. But neither fierceness nor gentleness is a criterion of behavior while posing.



Maybe the "Who's afraid?" would apply better to us than to this specimen from Mrs. Kauffeld's camera. But it's only a lizard—although a big one—an iguana. Lizards are apt to be nervous at first, but they soon settle down and aren't bothered by a flash



This handsome little fellow with a white beard—a Diana monkey—was actually terrified at almost the moment the camera was brought up although it had seldom had to pose for photographers. Its terror can be seen as it retreats in the cage

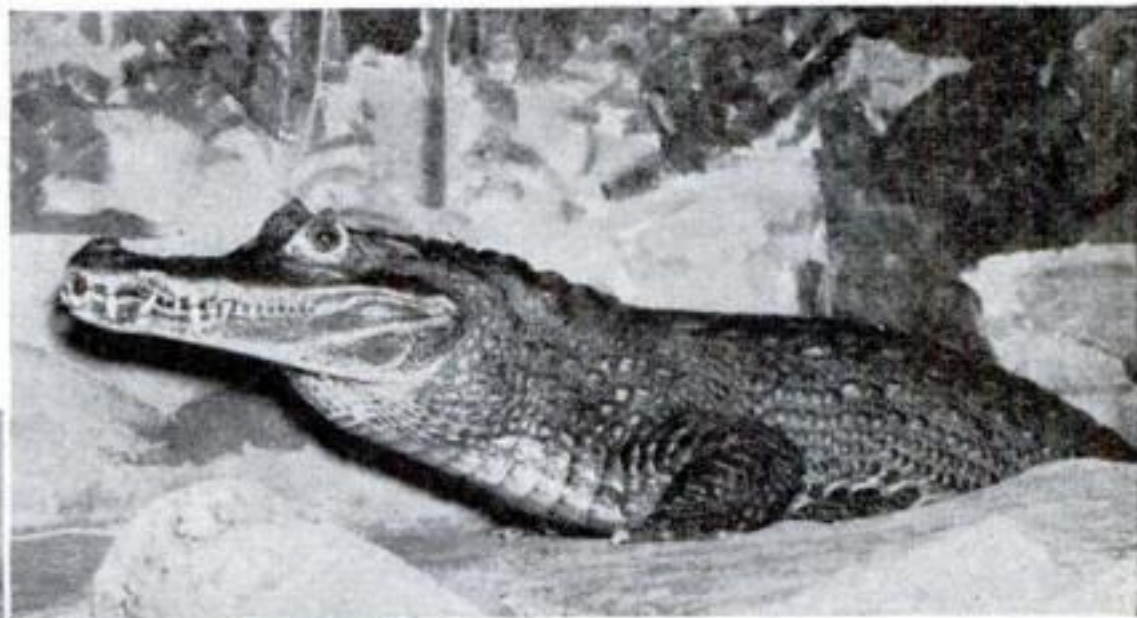


Just the opposite effect, if any, was produced on the big guy at the left. Hippopotamuses don't seem to be afraid of either the camera or the flash bulb; at least, they don't show it. This one kept its mouth open the whole while, hoping for food, no doubt, as its reward

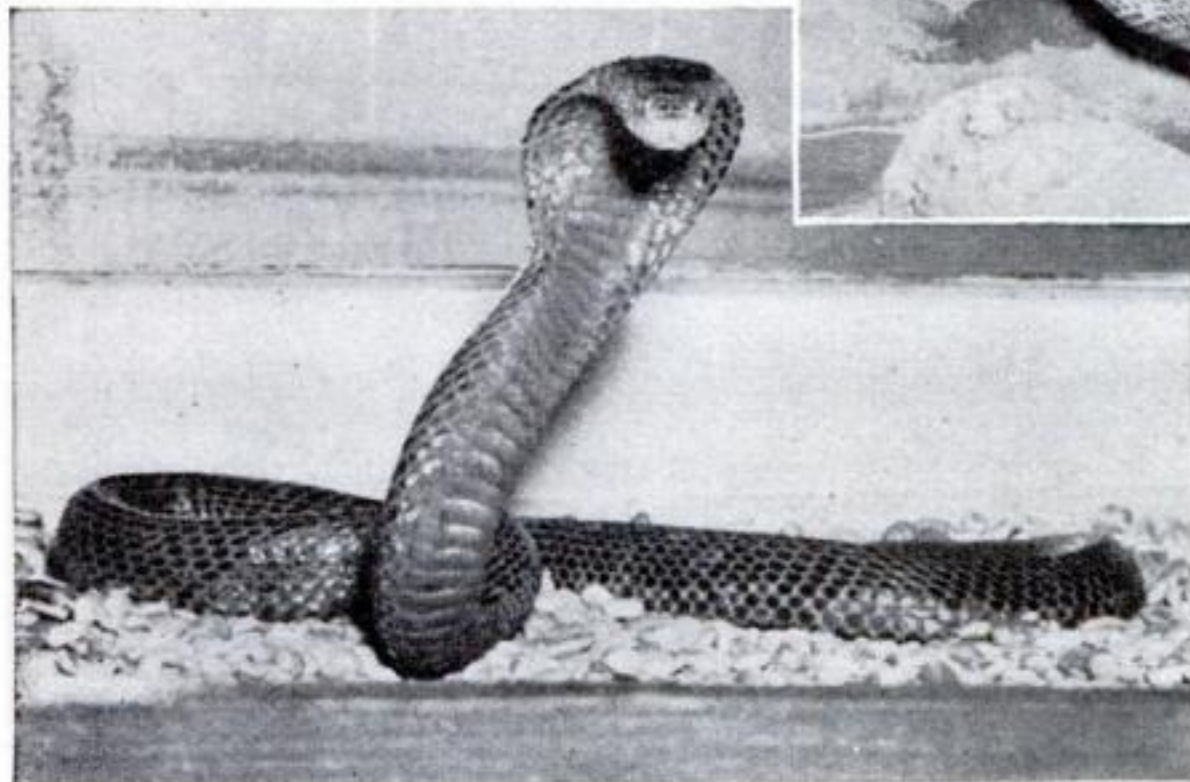
Look at the king of beasts. Leo may be the lord of the jungle, but in a cage when the photographer makes an appearance, it's a different story. This lion has been photographed many times, but its reaction is always the same—terror. Here it backs off as far as possible in an attempt to escape, crouching and snarling out in fear as the flash bulb goes off



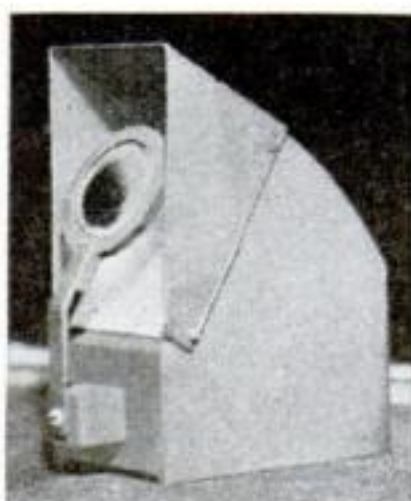
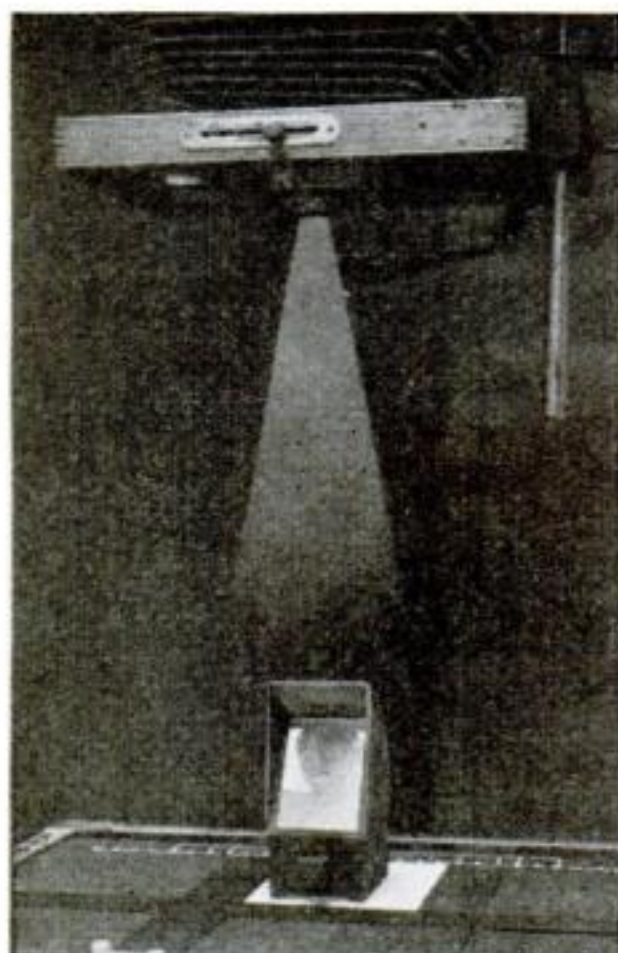
Very little can disturb the spectacled cayman shown below. All crocodilians are sluggish until aroused, but when not approached too closely, they will remain motionless even with bulbs flashing.



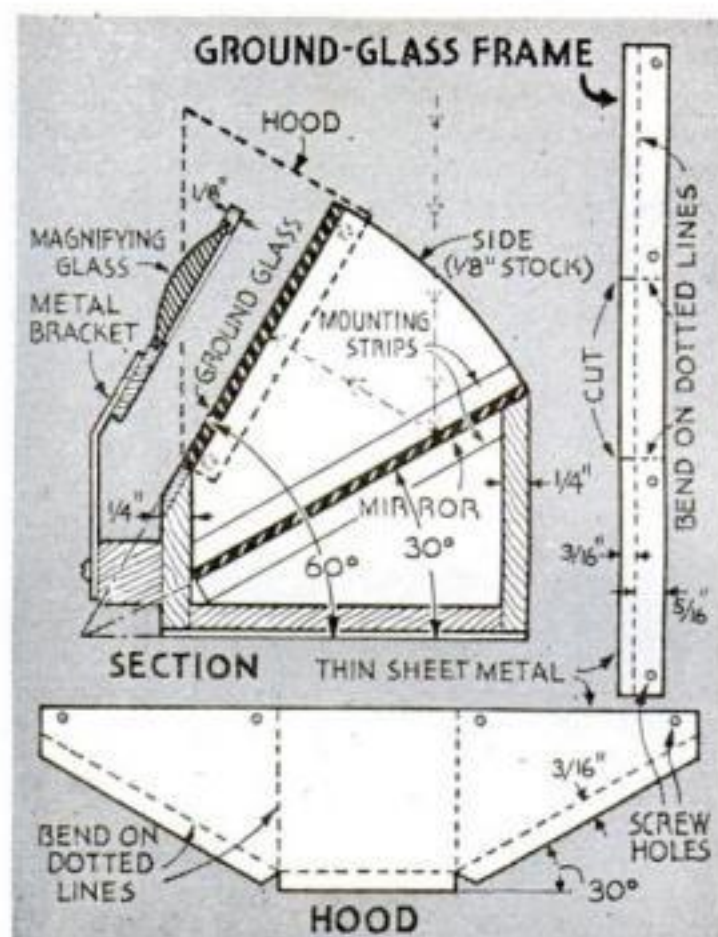
Trained animals such as sea lions take the camera and flash bulbs as part of life. Clarabelle here goes through her routine, clapping away with her flippers and not paying the least attention to the photographer



This last baby is one the photographer can have. An Asiatic spitting cobra, or any other cobra for that matter, is not our idea of a Powers model. For the record, though, snakes don't mind having their pictures snapped. They don't blink in the flash glare either—they can't, for they have no eyelids



Though not necessary, a magnifying lens is an additional help in obtaining the maximum sharpness. A block of wood, a metal arm, and a ring of composition board hold it. At the left, no lens is used



NEEDLE-SHARP enlargements are made easier with this focusing aid, which is a simplified version of several excellent commercial devices. The chief materials needed are a small handbag mirror, a ground glass, and several small pieces of $\frac{1}{8}$ " composition board. A magnifying lens is also useful.

As shown in the drawing, the composition-board sides project $\frac{1}{16}$ " below the base. To hold the mirror, two strips are glued to the sides at a 30-deg. angle with

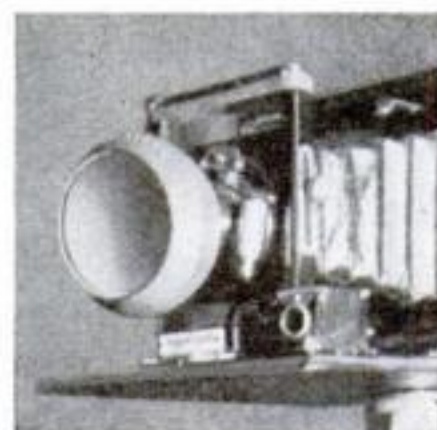
the bottom, and another pair of strips are attached above the mirror. The ground glass is mounted, ground side up, on the 60-deg. top edges of the sides; it is held from sliding by a small strip along its lower edge and retained by a metal angle strip. The hood shown is optional but useful. It can be made either by cutting a piece of tin-can stock to the pattern shown, or by extending the sides so that they serve as sides for the hood.—CARL W. BERTSCH.



DRYING PRINTS in a paper-towel roll is a handy trick, especially for those last few enlargements that are crowded out of the blotter roll or book. Simply unroll several yards of paper and place the prints so that when the paper is rolled up again, the emulsion side faces outward. If allowed to dry fully, the prints will have a curve sufficient to counteract their natural tendency to curl inward. The paper towels will not be harmed—GEORGE EICHER, JR.

SALON MOUNTS that have become dirty from long use or excessive handling need not be thrown away if they are in otherwise good condition. As a rule they can be cleaned perfectly with ordinary wallpaper cleaner. Rubbing the entire exposed surface with an eraser will also save a mount that seems destined for the wastebasket.—H. K.

A RUBBER LENS SHADE that will serve both to keep out unwanted light and to protect the lens and shutter from accidental blows may be made from a toilet-tank ball. Be sure to use the large rubber ball valve, not the float. Pry off the metal jacket, if there is one, and cut a hole on the opposite side to fit the lens barrel. Test the shade with a piece of ground glass or tissue paper to make certain the lens field isn't restricted.—HERMAN KLEIN.



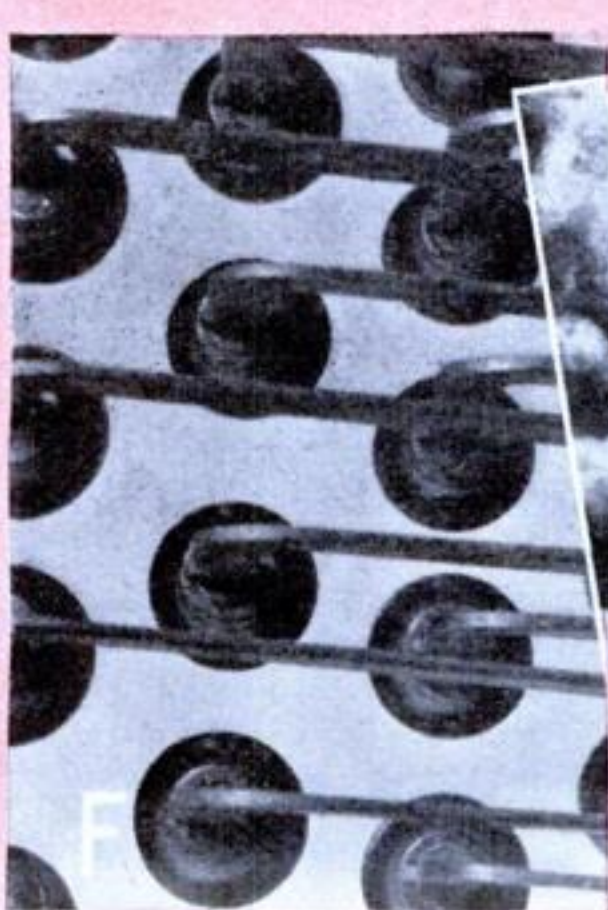
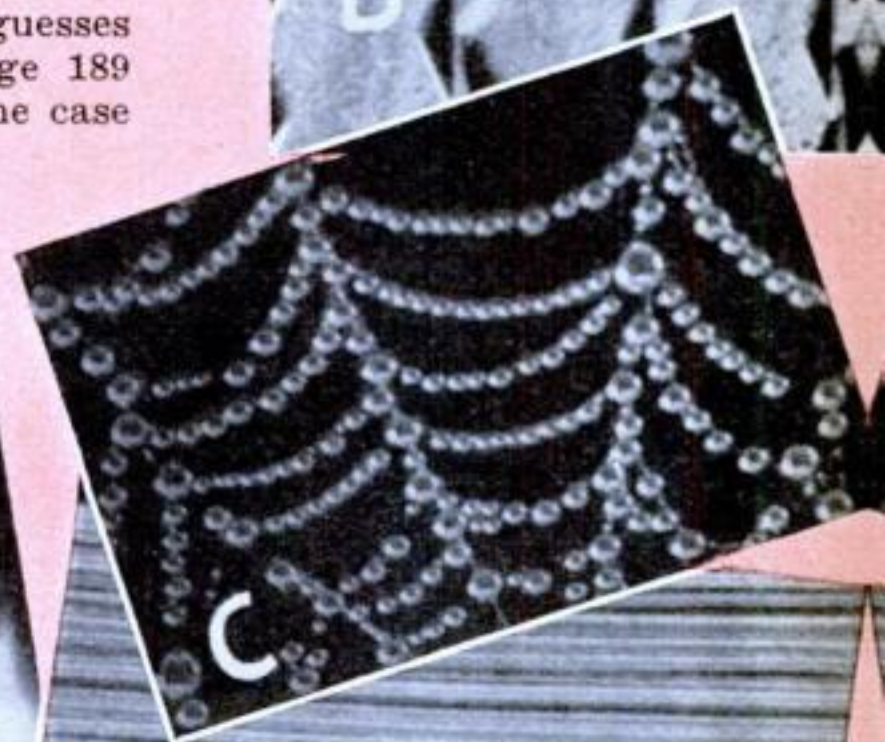
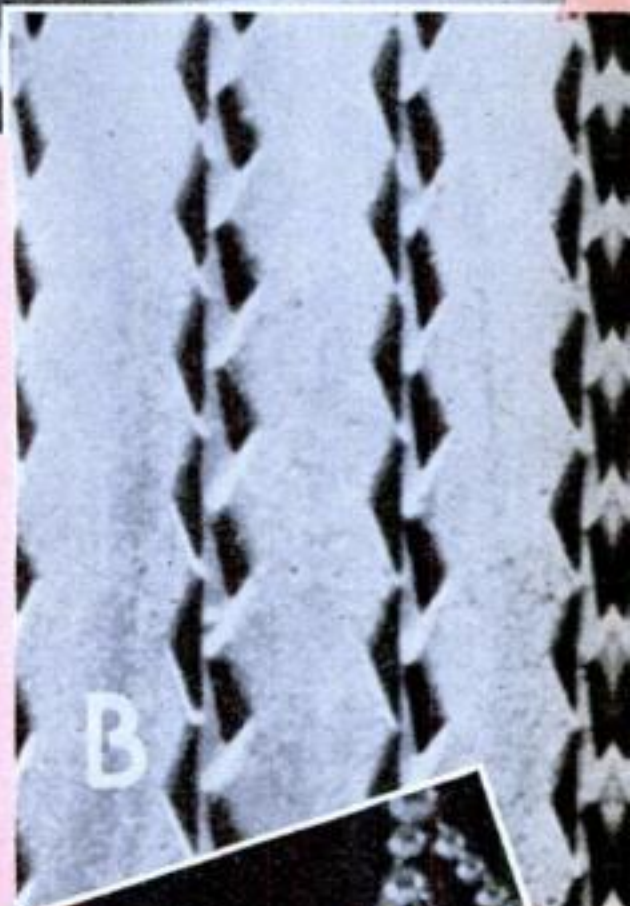
Prize-Winning Photo Puzzlers

LIST OF THE WINNERS

- 1st Prize: L. W. Bullard, Williston Park, N. Y.
2nd Prize: Frank J. Powell, St. Elmo, Ill.
3rd Prizes: E. Don Burkhart, Sioux Falls, S. D.
G. S. Frost, Jr., Baldwin, N. Y.
Wm. McGinnis, Jr., Nashville, Tenn.
Pfc. John R. Todd, Hunter Field, Ga.
4th Prize: Victor Williams, Price, Utah
5th Prize: Wm. Braverman, San Francisco, Cal.
6th Prize: C. G. Birckhead, Washington, D. C.
7th Prize: F. K. Sheckter, Philadelphia, Pa.
8th Prize: H. O. Bumann, Savannah, Ga.

REAL skill in a difficult branch of photography, plus imagination in the choice of subjects, marked a large number of the entries submitted in our recently concluded photo-puzzler contest. In fact, so many of the superclose-ups were of high caliber that the judges proclaimed a four-way tie for third place, adding three prizes to the \$50.00 in awards originally offered.

Some idea of the difficulties facing the judges may be gained by scanning the first six prize photos, shown in their winning order on this page. Don't forget, though, that it will probably be easier for you to identify these necessarily reduced reproductions than it would be with the original large prints. After you've made your guesses as to what these superclose-ups are, turn to page 189 for the right answers, shown photographically in the case of the first four winners. We'll give a couple of hints: picture *C* isn't a necklace, and picture *E* does not show a plate of doughnuts!





Give Your Photos Drama

**NAVY CAMERAMEN SHOW HOW TO CAPTURE VIVID ACTION
THROUGH CLEVER USE OF LINE, LIGHT, AND EMOTION**

WAR at sea and in the air has its essentially dramatic moments, and Navy camera artists have succeeded in embodying its drama in many unforgettable photographs. Those reproduced here were taken aboard carriers and escort ships on task-force service in the Pacific theater by a unit headed by Commander Edward J. Steichen, who in prewar civilian life was

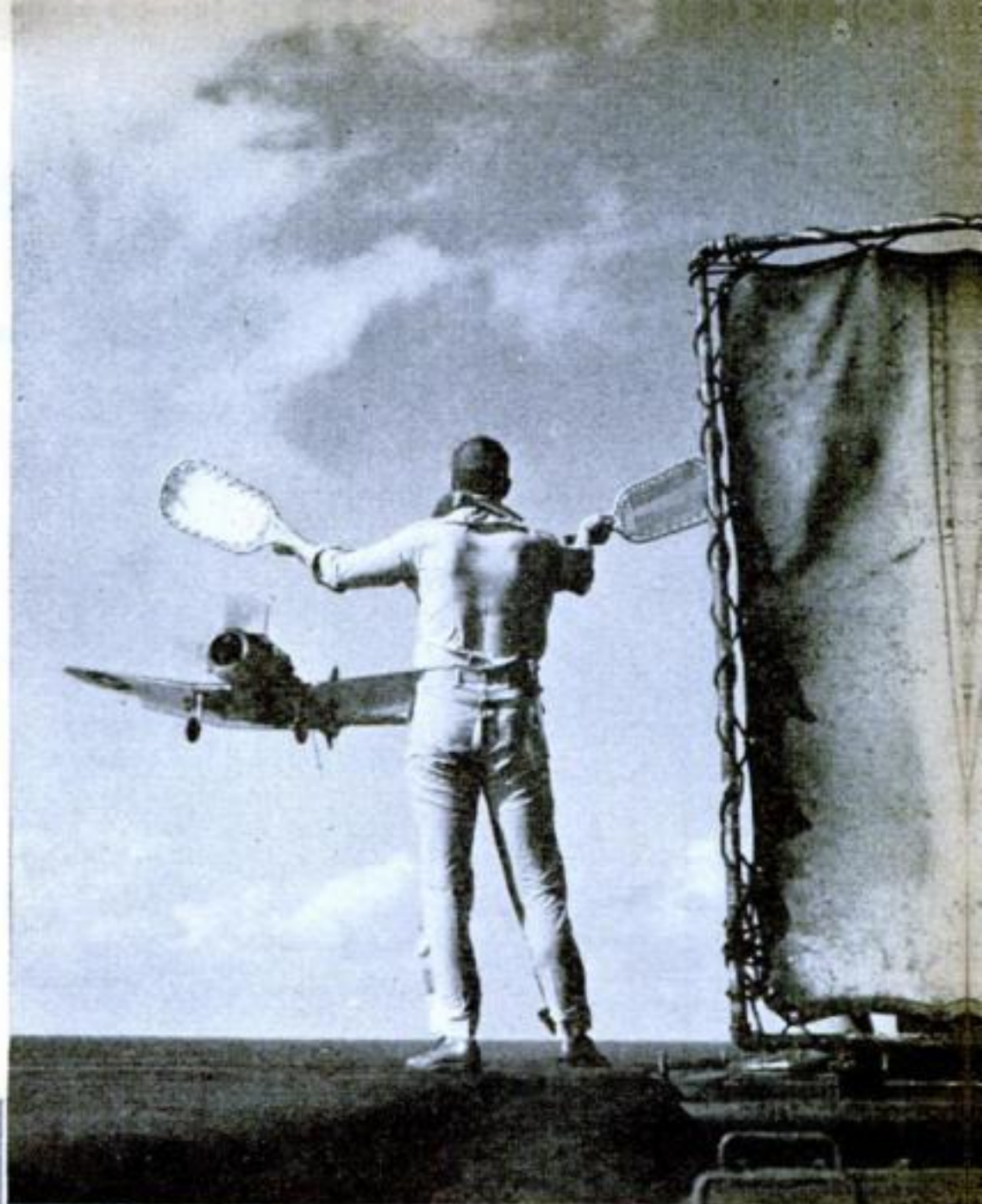
one of the world's outstanding photographers. Careful study of them will help advanced amateurs to get the same dramatic quality in their pictures even if they can't visit battle areas.

One of the many interesting features of these photographs is that, although none of them depicts violent action, they all tell the story of the Navy's air warfare every bit as

vividly and dramatically as do more sensational pictures of bursting bombs and crashing planes.

The picture on the facing page is a fine example of how "line" may be used to give dynamic action to a photograph. If the cameraman had made the exposure a second earlier or a second later, the result probably would have been a static picture of slight interest. By pressing his shutter release at exactly the right instant, he caught the crewmen at the moment when the lines of each man's body expressed purposeful movement. Another feature worth studying is the skilled use of light and shadow to give depth—to make you feel that you are looking into the picture rather than merely

← Moving a damaged plane on a carrier flight deck could have made a lifeless picture. It didn't—because the Navy cameraman snapped at exactly the instant every line of every crewman expressed purposeful action



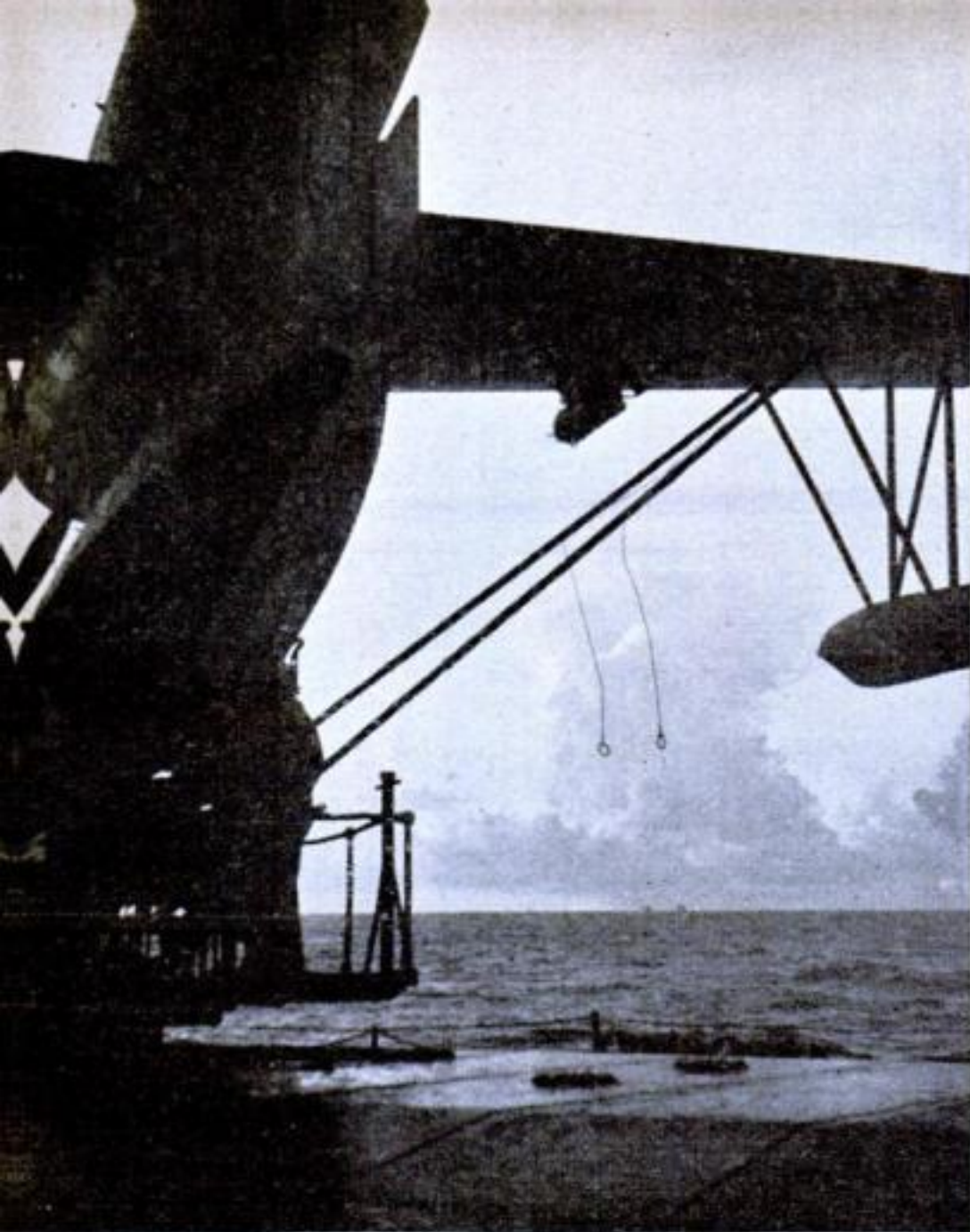
Skillful composition is what gives distinction to the photo above of a Dauntless dive bomber signaled back to its carrier. At left, returned from a strike, a pilot tells his story. The smiling airman in the background helps make the photo a standout. Below, shutter release at the right moment puts drama in this Hellcat-fighter pilot's return

looking at a representation printed on paper.

Still another interesting example of the use of "line" in composition is provided by the reproduction at the top of this page. Notice the clever arrangement of vertical and horizontal lines.

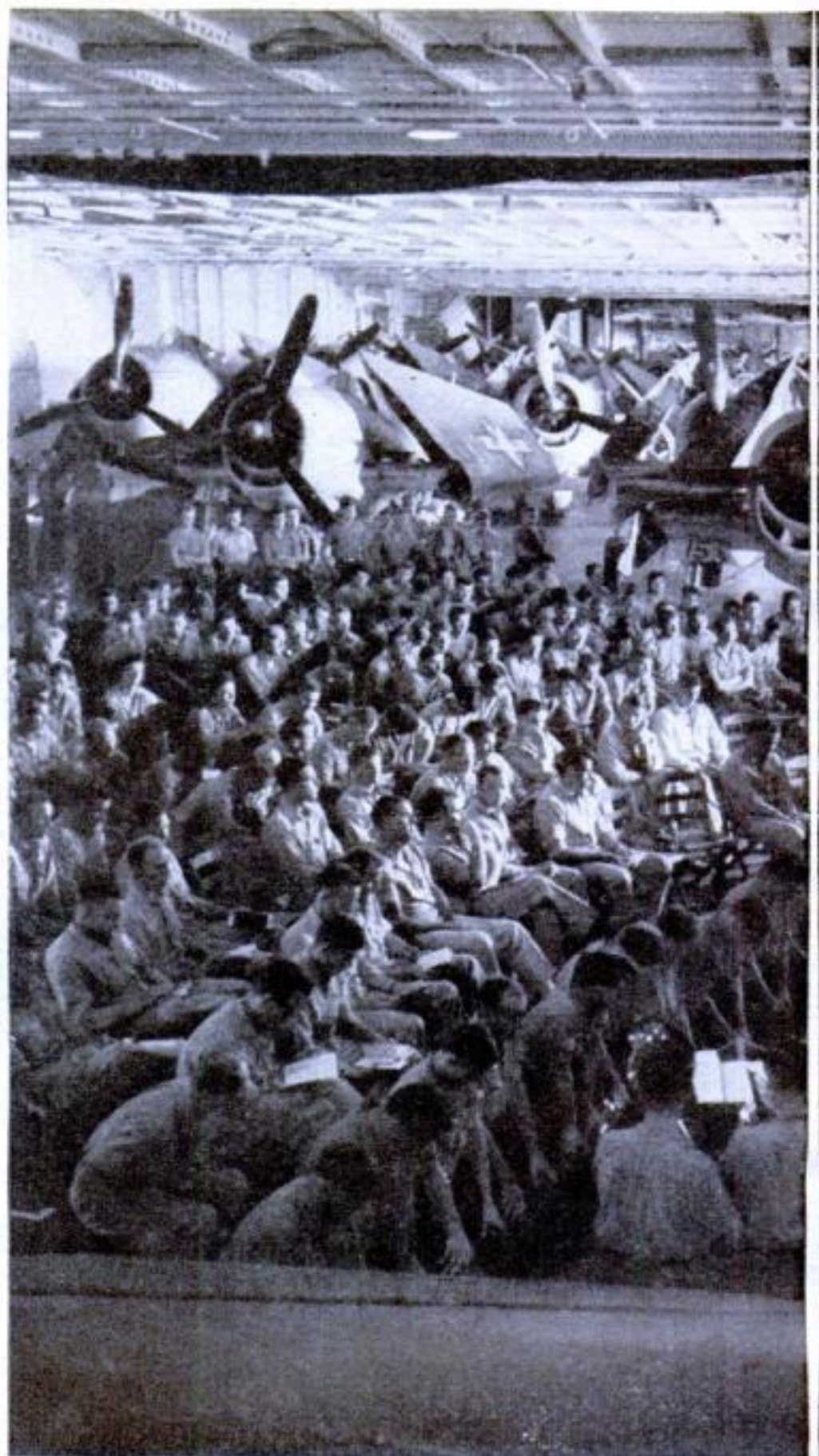
The photograph at the center of this page





Taking the plane against the sky puts the feel of leashed power and grim purpose into the photograph above of a Kingfisher Scout on a catapult aboard a light cruiser. At right, excellent composition combined with effective use of light and shadow gives this unusual picture of divine service on a carrier hangar deck exceptional emotional appeal

Alertness by the Navy cameraman caught the study in expressions below as crewmen near a loudspeaker listened to a pilot's grimly amusing battle tale



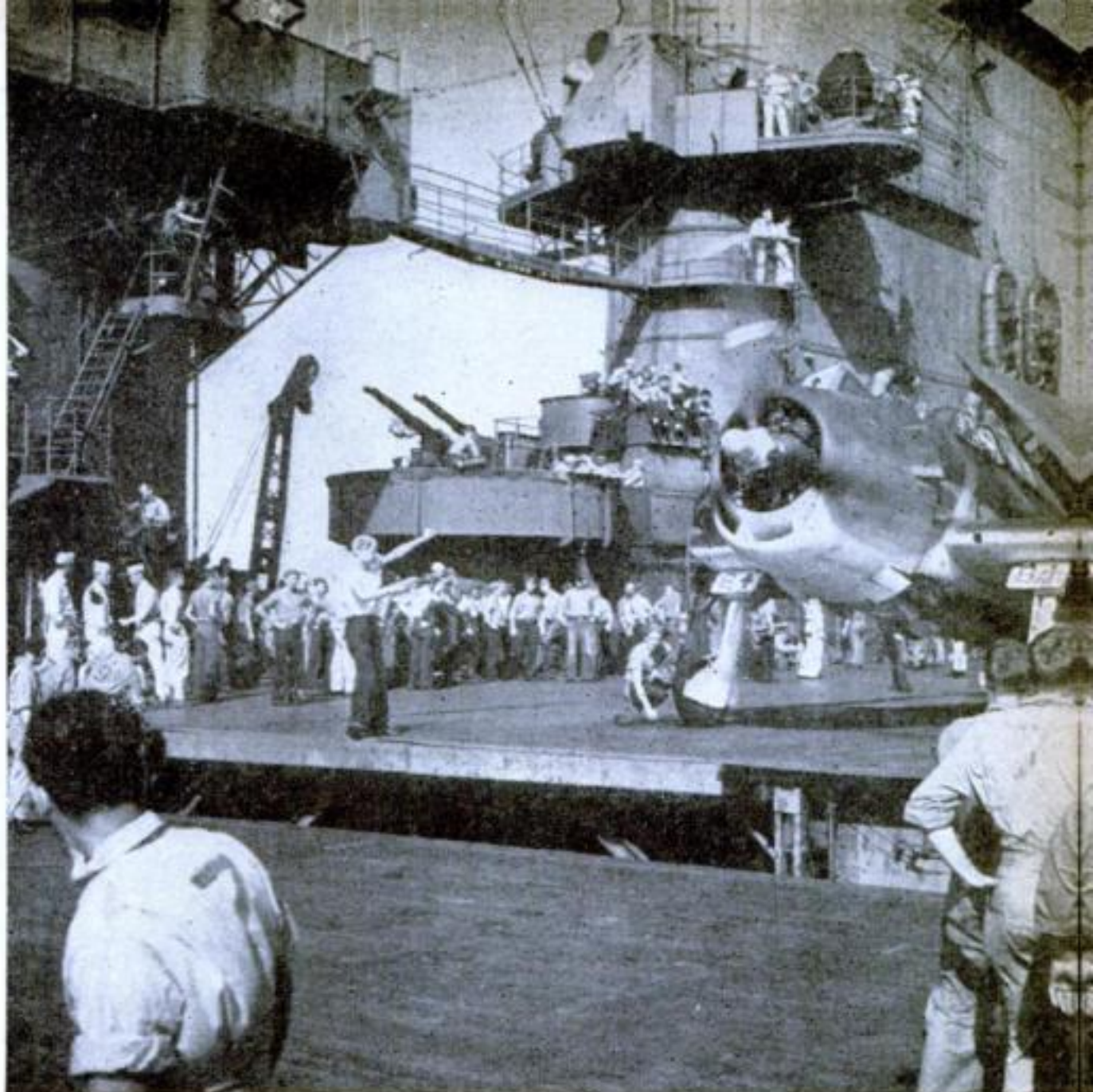
was taken in the pilots' ready room on a carrier. Pilots of dive bombers who have returned from a strike against Wake Island are reporting to interviewing officers. One of them is telling what his 1,000-pounder did to a Jap installation. His gesture gives the composition action. But the smiling listener almost hidden in the background also helps to hold the picture together and to drive home its story. Put the tip of your finger over his face and see how much the photograph loses in meaning and drama.

At the top of the facing page is a photograph of a Hellcat fighter being maneuvered into position on the



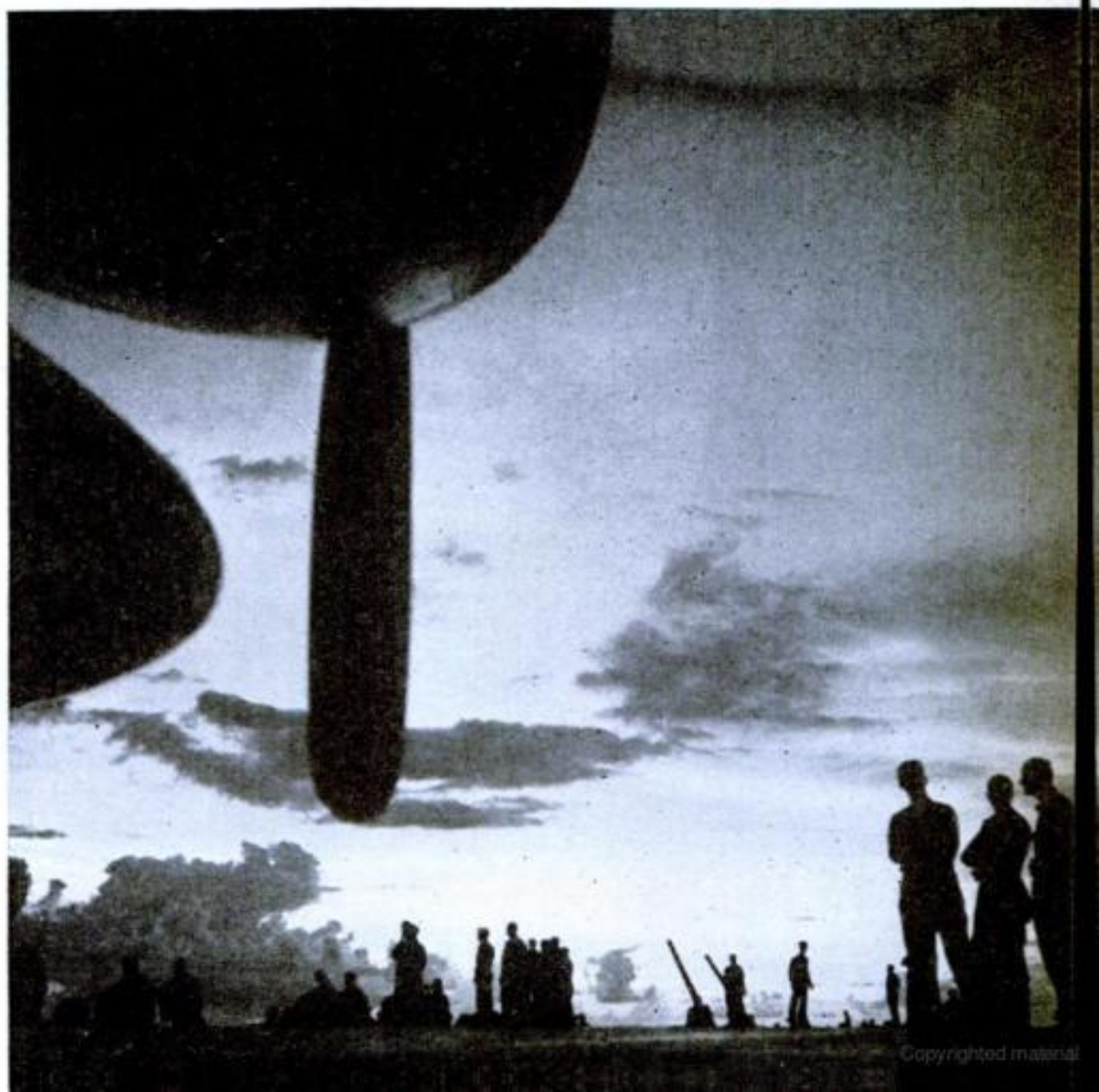
flight deck of a carrier. It is another excellent example of the use of an unobtrusive but dominant figure to give a picture meaning. The white-helmeted plane parker is scarcely noticeable at first glance, but without him the photograph would be almost static and almost meaningless.

Emotional appeal is a rare quality even in good photographs. The picture of divine service before action on the hangar deck of a carrier has it to a notable degree. Excellent composition and lighting, and the fighters in the background, make it a remarkable photo.



Plane handling on a carrier is routine, but exceptional composition and use of light and shadow add drama to the photograph above of a Hellicat being maneuvered into position. Note how the plane parker—wearing the white helmet—puts action and meaning in the picture

Silhouetting men, planes, and antiaircraft guns against a Pacific dawn dramatizes the fundamentals of naval air power in the picture below. It was taken on a carrier moving in to strike against Rabaul



This way to the Conways-- Come up and help us lay a brick!



THE CONWAYS
YAUGHN ROAD
JAITE, OHIO

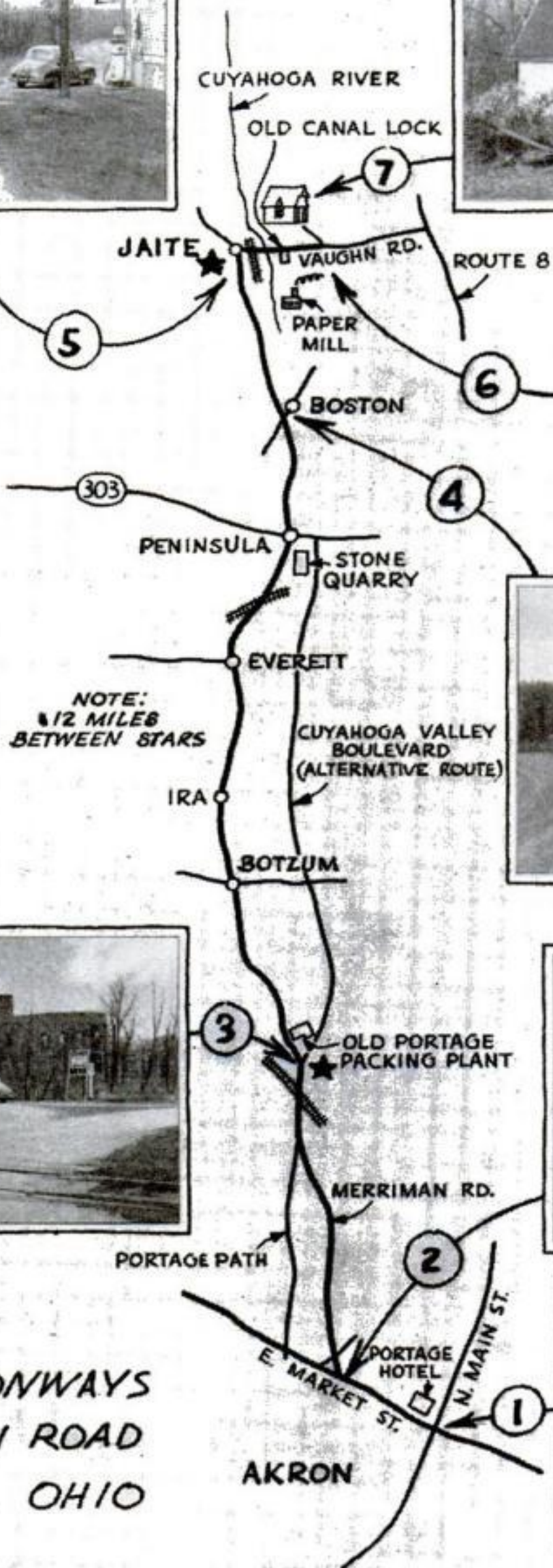


PHOTO MAP TO DIRECT YOUR FRIENDS

IF PEOPLE have difficulty finding your home, a photo map may save your visitors time and trouble. Similar maps may be useful for directing groups to a picnic ground.

Sketch on a large sheet of paper a map showing the main roads, intersections, and turnoffs between starting point and destination. Then select points at which someone could go astray and photograph them—preferably showing a readily distinguishable

landmark and an auto headed in the right direction. Trim the prints, paste them on the map where they won't cover essential details, and connect them with arrows to the points they depict. Use black India ink for all markings. Indicate mileage between points where possible.

Finally, photograph the map to get a copy negative and make as many prints as desired to distribute to your friends.

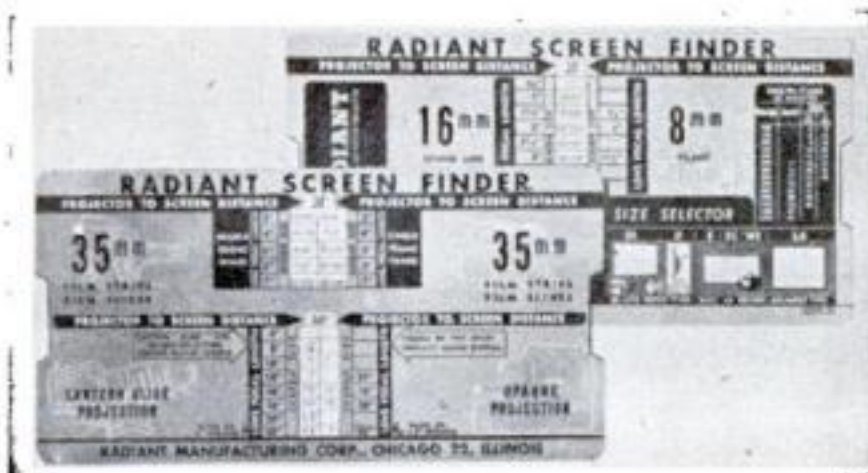
FOR CAMERA USERS



FILM-TRANSPARENCY VIEWERS with an adjustable eyepiece are now molded from plastic and include a light-diffusing unit of frosted celluloid. Focusing to suit the individual eye is accomplished simply by turning the eyepiece in front of the lens until the film or color transparency in the holder can be seen clearly. The new viewers are produced by the Plastic Die and Tool Corporation, of Los Angeles.

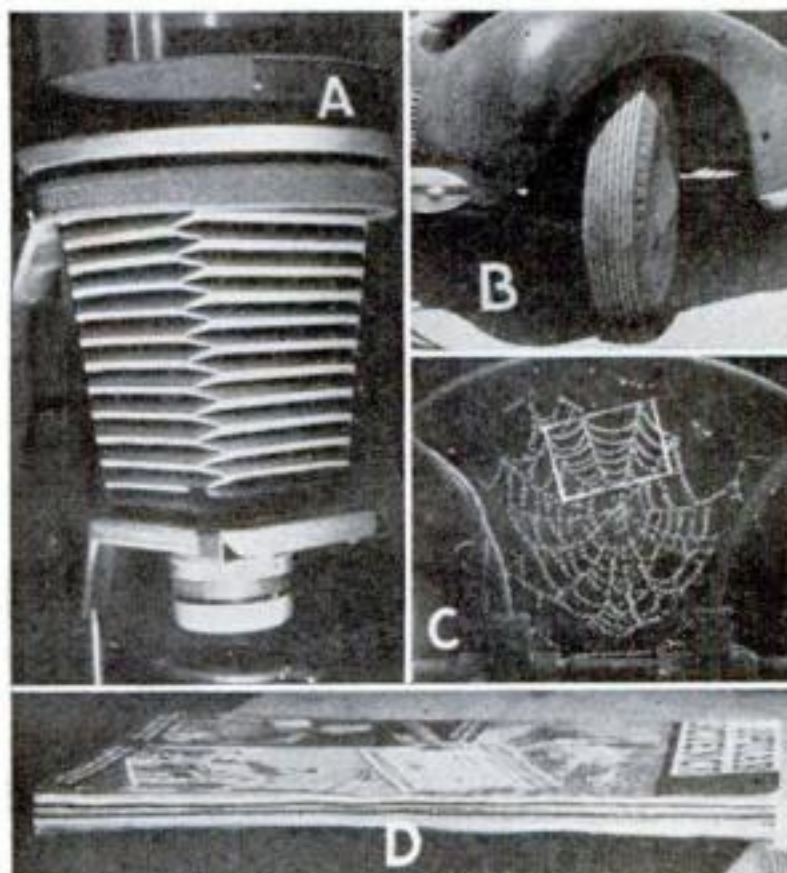
COLOR FILM HAS NOW APPEARED on the civilian market in a type that can be processed at home by the user. Developed by Ansco at the request of the Army and Navy for a color film that could be processed in the field, it was until recently available only for the armed services and for war industries. The new film is composed of three layers of photographic emulsion containing colorless dye-forming substances. It can be processed in 90 minutes, only 15 of them in total darkness.

WHAT SIZE MOVIE SCREEN is best suited for various distances between screen and projector with a given lens is answered by a pocket slide scale that is durable, compact, and easy to read. Made by the Radiant Manufacturing Corp., of Chicago, it also tells what model screen to select for particular needs, distance between screen and projector for a given size picture, the lens to use, and showing time for 8-mm. and 16-mm. film. Similar data for slide projection appears on the reverse side.



ANSWERS TO PHOTO PUZZLERS

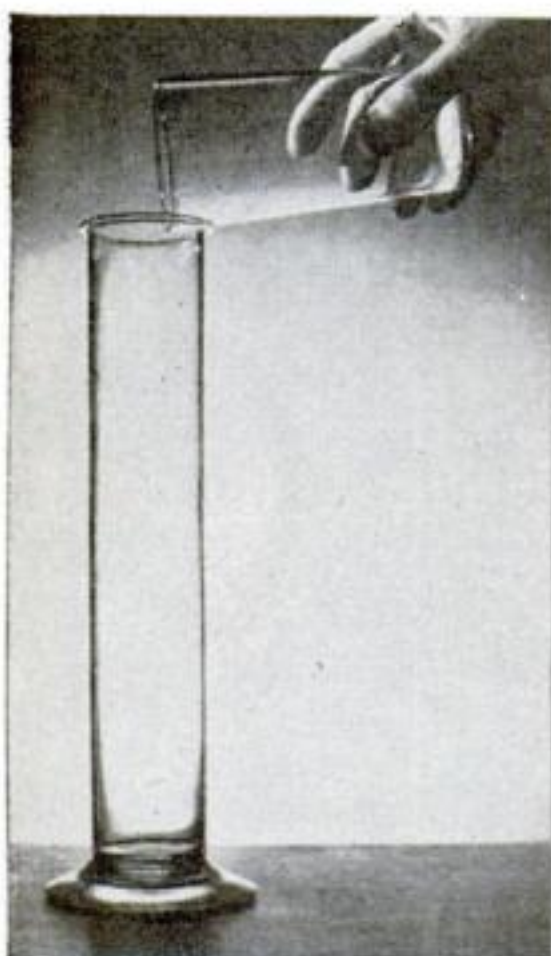
Below are the answers to the photo puzzlers on page 183. A. Folds of an enlarger bellows. B. Auto tire tread. C. Dew on a spider web. D. Edge of a magazine. E. Cheerioats cereal. F. Typewriter keys.



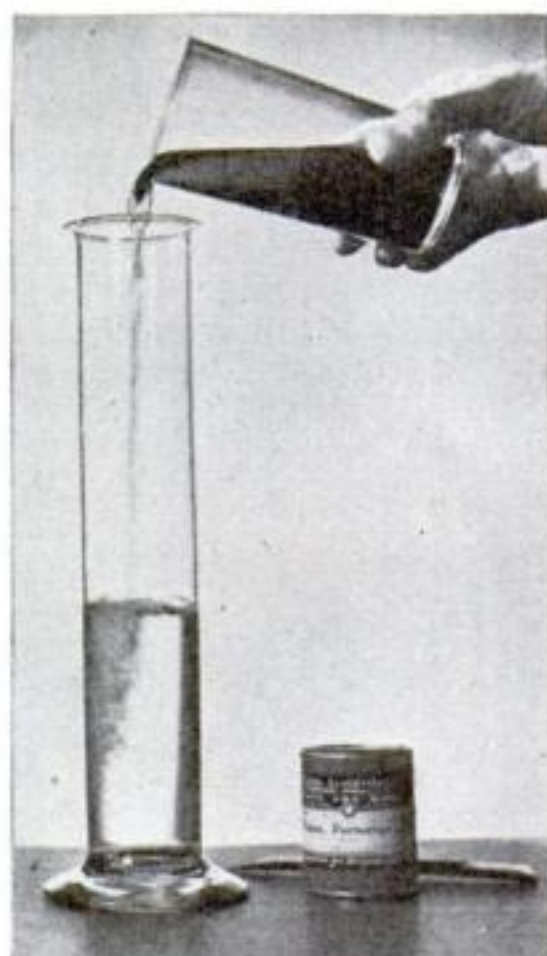


GASES ARE LIGHT in weight, but many are heavier than air. Some, such as gasoline vapor and vapor from carbon disulphide, are also inflammable. For a dramatic demonstration, put a few drops of either liquid in a tin can from which the top has been removed. Use only a few drops and *keep the supply container far from any open flame*. After a minute or so, go through the motions of pouring the vapor into another can. Now pour the second can over a candle flame. There will be a sudden flash—harmless if you have used little liquid—showing both that the vapor really has been poured into the second can and that it burns.

CARBON DIOXIDE GAS is another that is heavier than air and can also be poured like water, but it differs from gasoline vapor in that it will put out a flame. This property makes it one of the important agents used as fire extinguishers. Put a little bicarbonate of soda (baking soda) in a large glass and add a little vinegar. Carbon dioxide gas will soon fill the glass. To prove it, pour the gas over a candle flame, and the flame will be extinguished. For a still more impressive demonstration, pour the gas through a mailing tube or down a paper trough, as shown at right, to show that the gas readily follows the incline to put out the flame.



VISIBLE CHANGES in solids and liquids are caused by some gases. Make sulphur dioxide gas by adding a little of any of the common acids to a small quantity of sodium sulphite or sodium bisulphite, and pour the gas into a tall glass, as at left, covering the glass to keep the gas in. Dissolve some potassium permanganate in water to make a pale-violet solution, and pour this into the apparently empty tall glass, as at right. Sulphurous acid formed by the gas and water will bleach the liquid clear. This is an impressive stunt if prepared just before visitors come to your lab. It's best to perform it with the windows wide open, though, as the strong odor of the sulphur dioxide is likely to be unpleasant in a closed room.



OXYGEN unites so readily with some substances that the result of the reaction enables us to determine the proportion of oxygen in air. To 1 oz. water in an 8-oz. bottle add half a teaspoonful of one of the photographic developers, hydroquinone or pyro, and an equal amount of common lye. Stopper the bottle quickly, invert it, and mark the level of the liquid on the inverted bottle. Let the solution cool (the lye will have heated it) and then shake it vigorously. Oxygen will leave the air in the bottle and go into the solution, turning it almost black, a product of oxidation familiar to all who have used and stored photo developers.

Hold the mouth of the bottle under water and withdraw the stopper slightly, lowering



the bottle to equalize the level as outside pressure forces water in. Replace the stopper when the flow has stopped, and remove the bottle. Now compare the level of the liquid with the earlier mark, and you will find the ratio of displacement approximately 1 to 5—the proportion of oxygen in air.

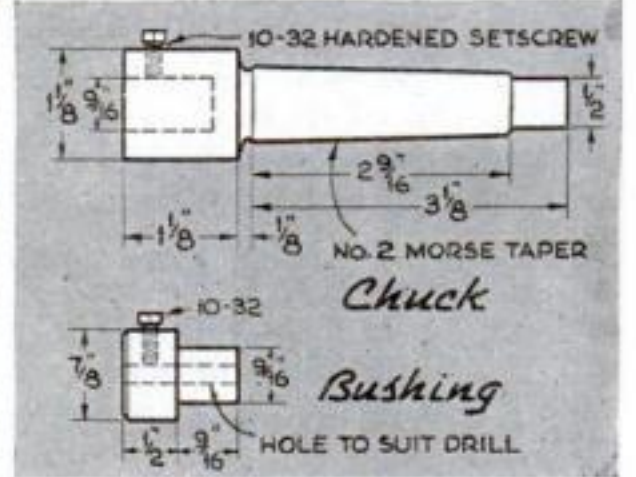
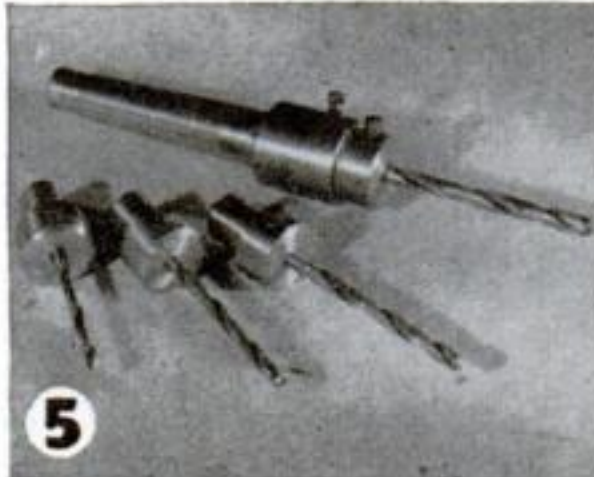
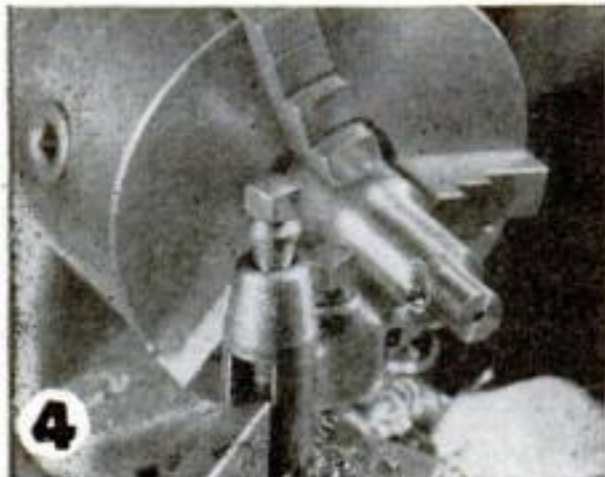
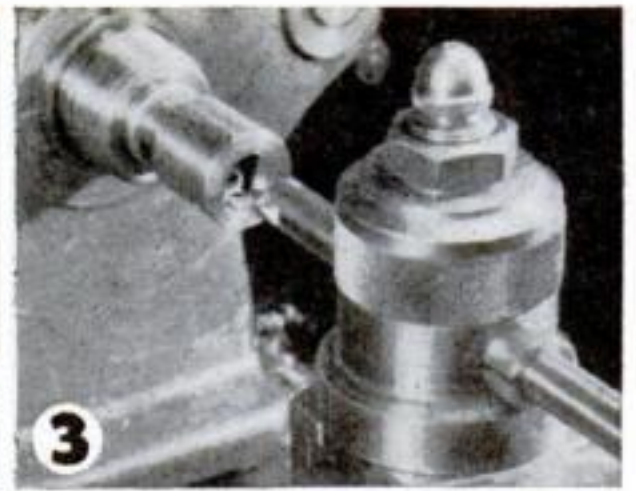
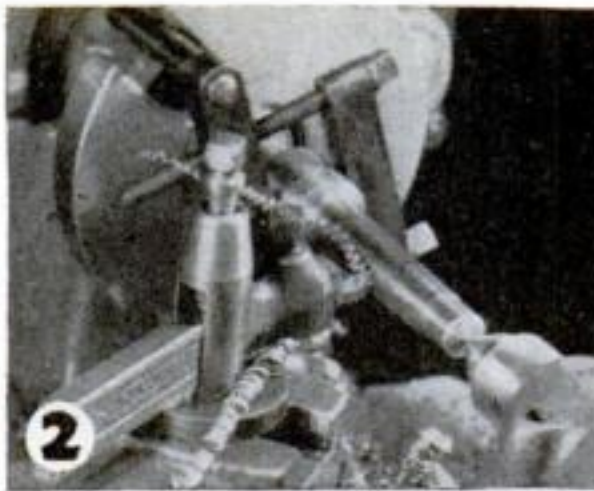
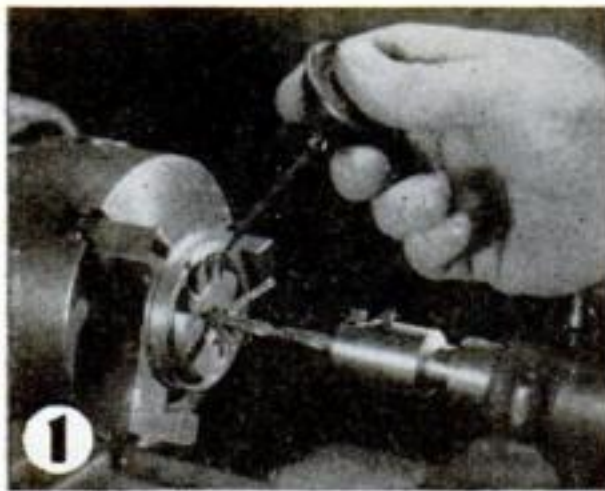


POROUS MATERIALS, such as charcoal, silica gel, and spongy platinum, have the power of absorbing gases or of holding them closely to their surface. That is the reason why materials of this kind—some with microscopic pores—are employed in removing food odors, in keeping poison gas from pene-



trating gas masks, and as catalysts to unite several different gases. A little powdered charcoal will demonstrate this principle of absorption. Use it with a harmless gas, such as the vapor from a moth ball, that can be detected easily by smell.

Put a moth ball in a jar and then remove it when the jar begins to give off a strong odor of naphthalene. Next, add a teaspoonful of the powdered charcoal to the jar, screw on a cover, and shake the container vigorously. Allow the charcoal dust to settle, and then uncap the jar and smell it again. The naphthalene odor will have completely disappeared, showing that the charcoal has absorbed the gas. In this case each of the charcoal particles holds the naphthalene vapor securely to its surface.



Tapered-Shank Drill Chuck and Bushings for Use In a Lathe

A CONVENTIONAL drill chuck for use in a lathe is rather expensive. Here (Figs. 1 and 5) is a simple substitute consisting of a tapered-shank chuck and a set of bushings, each of which has a hole to take a drill of a specific size. The tool may be used either in the headstock or in the tailstock, as the job demands.

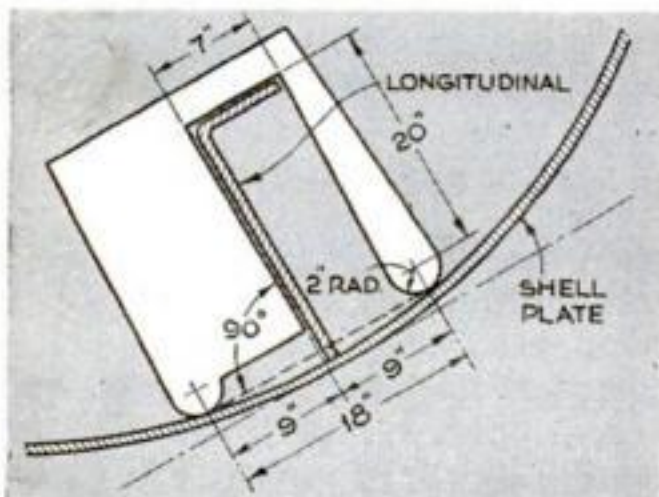
To turn the Morse taper shank, mount the material between centers on the lathe and add a lathe dog. Using the set-over tailstock method, rough-turn the taper, leaving the small end about .020" oversize (Fig. 2). Test the work by using the tailstock as a taper gauge. If the taper is correct, the tailstock will slip on for about three fourths of the length of the shank and there will be no play or shake. If a perfect fit is not realized, change the setting of the tailstock, take a light cut, and try it again. After obtaining the correct taper, turn the shank to size with light cuts, testing it frequently.

Before making the final cut, coat the taper with Prussian blue and twist it into the tailstock. If smudging indicates it is seating evenly, make the final cut and polish the shank with emery cloth.

Remove the lathe center and slip the tapered end of the work into the headstock spindle (Fig. 3). Turn the unfinished end to size and bore a 9/16" hole to receive the bushings. The chuck is completed by drilling and tapping a hole to take a 10-32 hardened setscrew.

The bushings are turned to size from short pieces of stock (Fig. 4), centerdrilled, and cut off. Each center hole is opened out with a drill of the size that is to be used in the bushing. Both ends are faced, smoothed and the larger end is chamfered, as indicated in the drawing. A hole is drilled in the head of each bushing to take a 10-32 setscrew. Hollow-head setscrews are preferable to the kind shown.—C. W. W.

Gauge for Setting Members Vertical to the Chord of a Curve

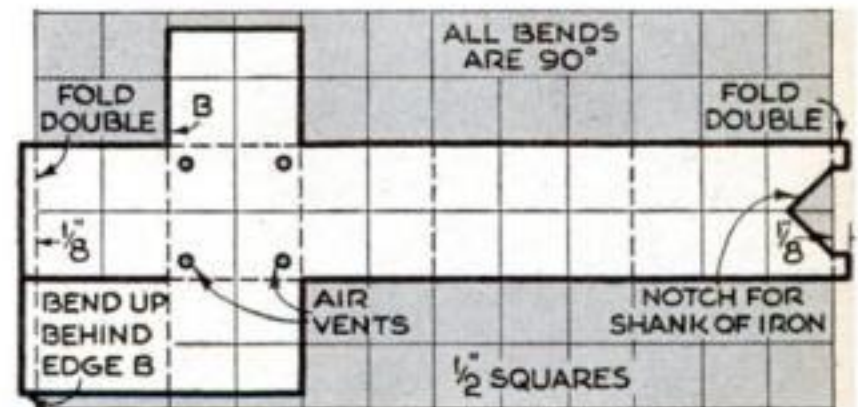
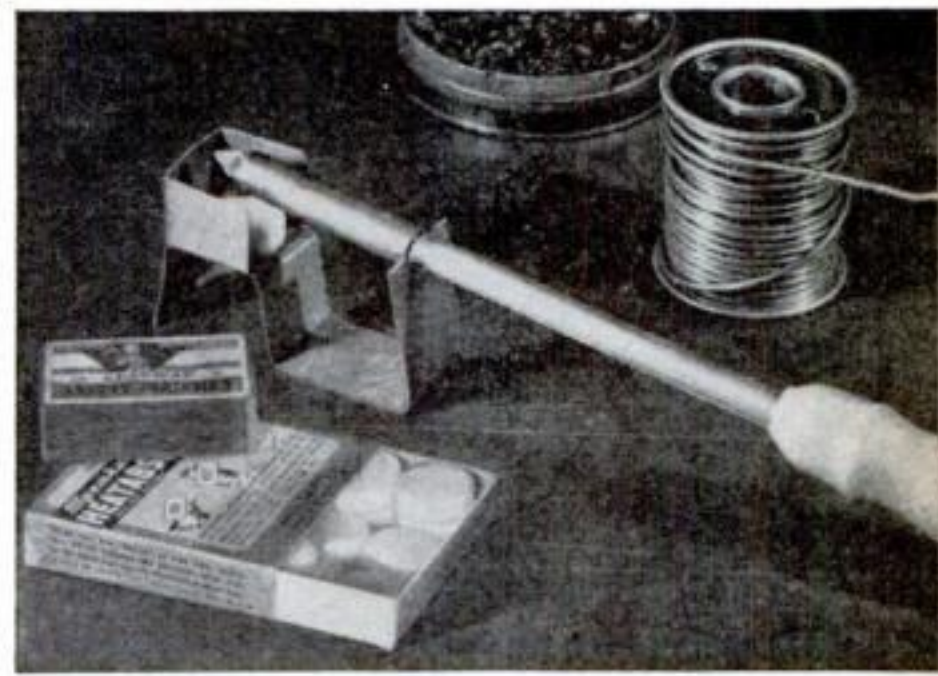


CLAY DYER, a loftsmen at the Marinship Corporation, Sausalito, Calif., designed this gauge as a device for quickly setting longitudinals at right angles to curved shell plating. With the former method it was frequently necessary to scarf and reset various longitudinals when they failed to meet the connecting brackets properly.

While this gauge was primarily designed for use in the shipbuilding industry, it could be adapted for use in other structures—such as tanks or silos—where a member must be aligned vertical to the chord of a curved surface.

Soldering-Iron Heating Stove Uses Concentrated Tablet Fuel

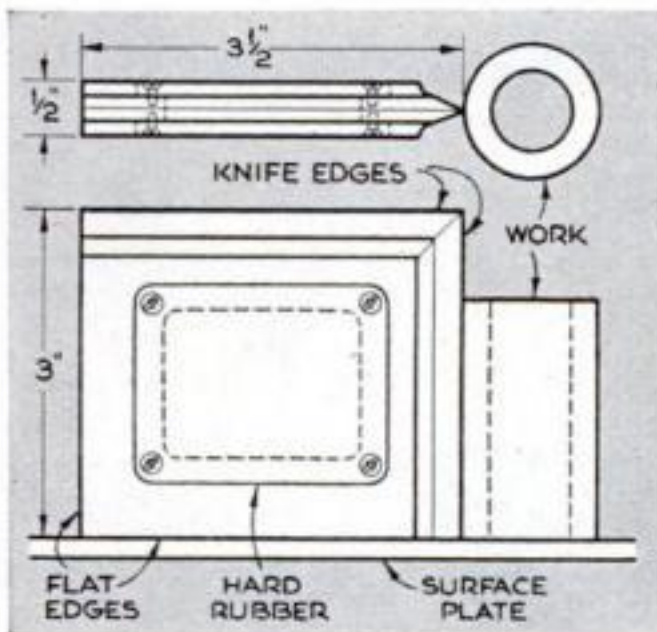
WHEN ordinary heat sources are not available, a small soldering iron may be heated with tablet fuel in this tiny stove, which is made from scrap sheet metal or tin-can material. (The soldering iron shown in the picture is an old electric one, the element of which had burned out.) Cut the metal to the shape shown in the drawing and bend it as indicated. Punch a hole near each corner of the fuel recess to improve the draft. Use fuel tablets that are $\frac{7}{8}$ " in diameter as a source of heat—a small one burns about seven minutes and a large one twice that long.—W. E. B.



Washers Under Motor Kill Noise

IF A small electric motor is mounted directly on a stand or bench, it may be quite noisy. This tendency may be overcome by providing a sound-deadening cushion mount in the form of one or two garden-hose washers under each of the motor supports.—LOUIS CHIREY.

Universal Box Square Insures Perfect Small-Part Alignment



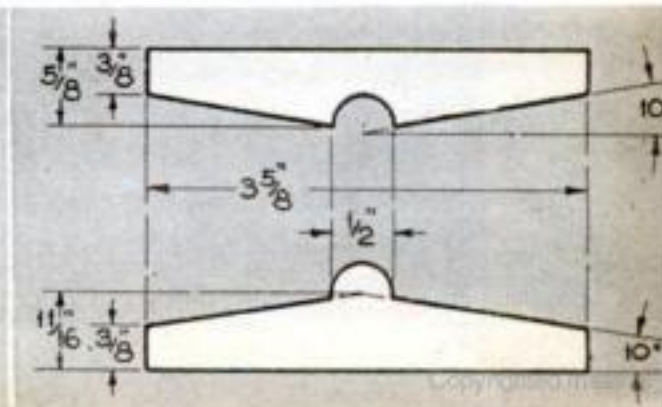
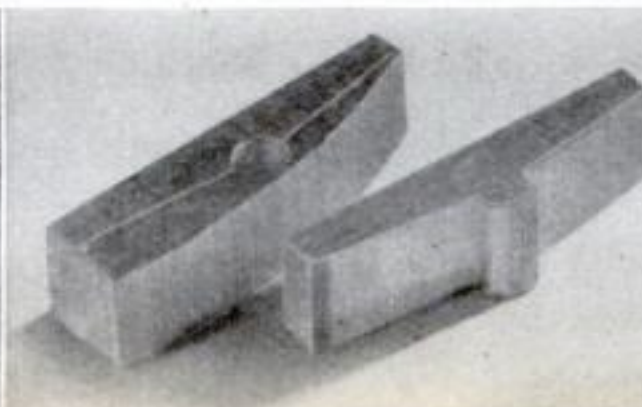
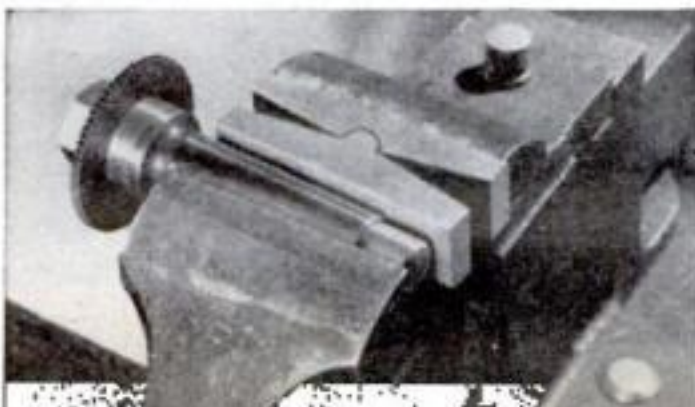
FOR checking small parts where extreme accuracy is required, this universal box square will prove to be handy. It is made of a $\frac{1}{2}$ " by 3" by $3\frac{1}{2}$ " piece of tool steel. Square the material all around and, using a $\frac{1}{4}$ " end mill, machine out the center, as indicated by the dotted line in the accompanying drawing. Such an end mill will give a good radius at the corners. Then, using the same end mill, rabbet both faces to take hard-rubber inserts, which are held in place by 8-32 machine screws. Shape the two knife edges as shown, preferably in a shaper with the tool head set at 30 deg. Round the faces into the knife edges with a $\frac{1}{16}$ " radius tool to give a neat, finished appearance. Finish the square by hardening, grinding, and lapping accurately to size.—H. D. CHAPMAN.

Swivel Taper Blocks Hold Tapered Work Securely In a Vise

THE problem of how to hold tapered work in a vise can readily be solved by using a pair of swivel taper blocks, as shown below at the left. These blocks automatically set themselves to the angle of the work and hold it securely without damage or danger of slipping.

They can be made from cold-rolled steel, brass, or other scrap material. The center

illustration, below, shows them partially completed. The semicircle in the female piece is drilled, as shown, before the block is finally cut to shape. Both pieces can be formed accurately on a metal-cutting band-saw or a shaper. They should be finished by hand filing to obtain an accurate swivel joint that will rock freely and adjust itself to the work being held.—C. W. W.



POSTWAR HOME HEATING WILL BE DIFFERENT . . .

Good-By to Coal

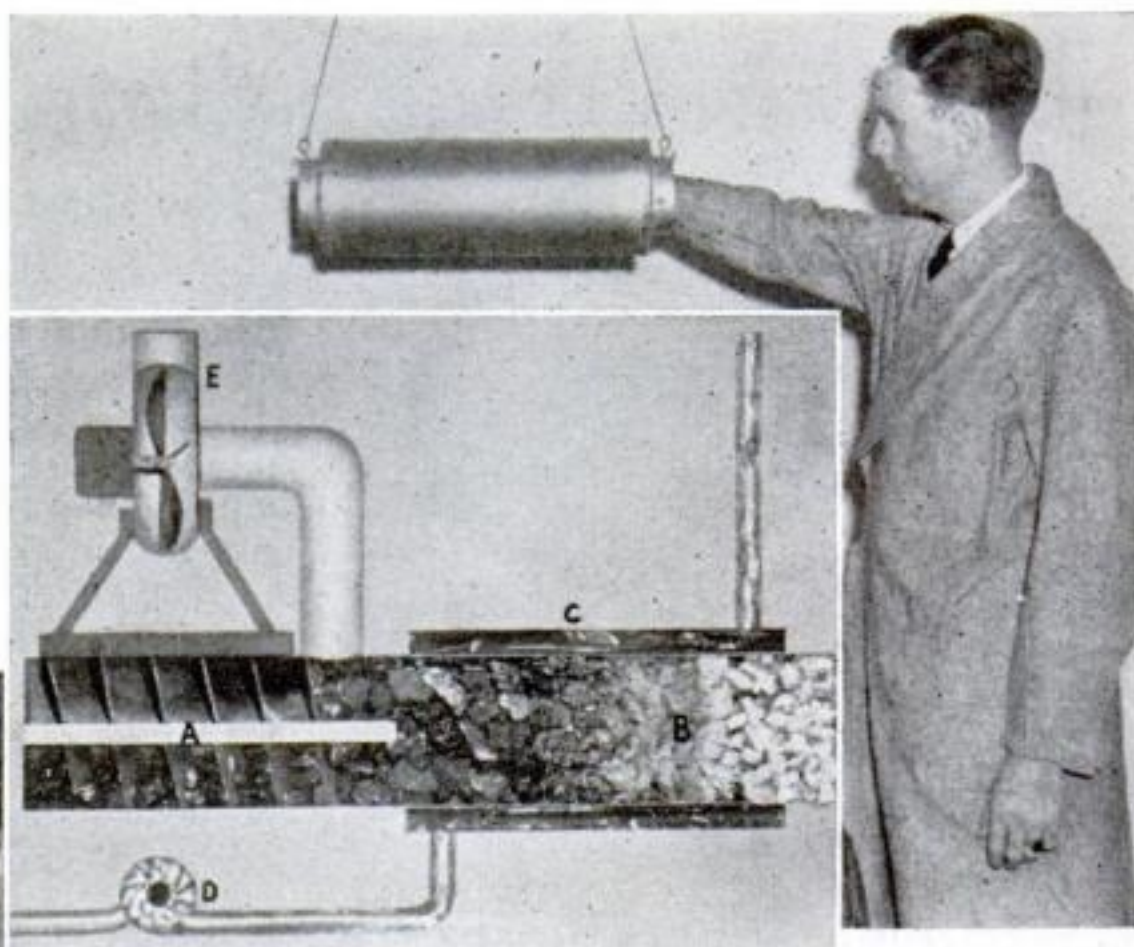
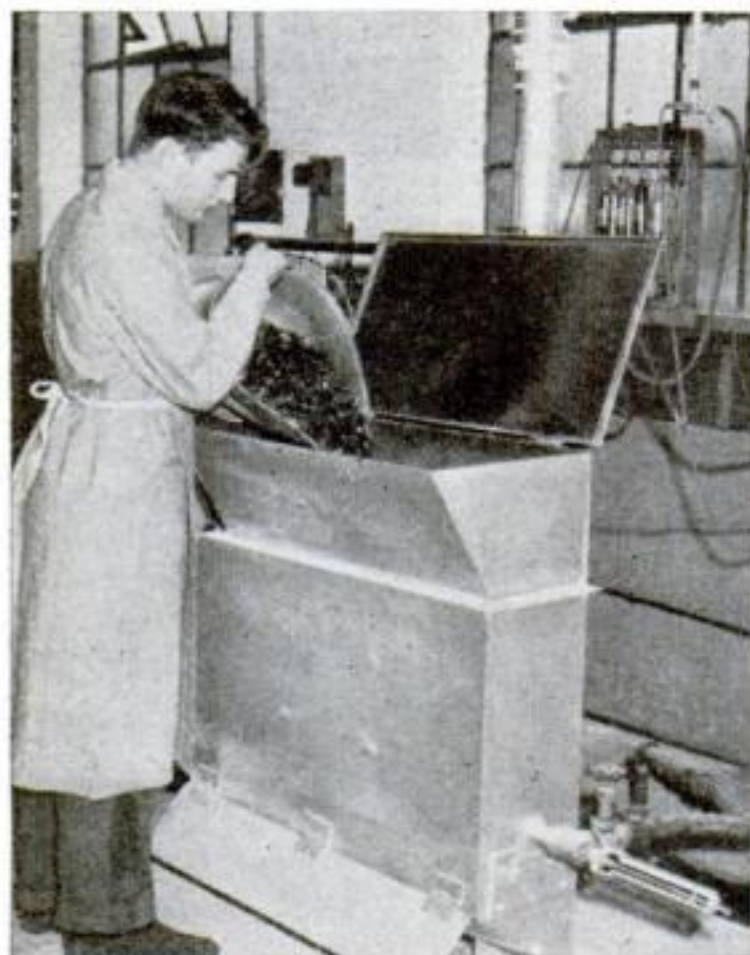
"VEST-POCKET" FURNACES OF RADICALLY DIFFERENT DESIGN

By GOLD V. SANDERS

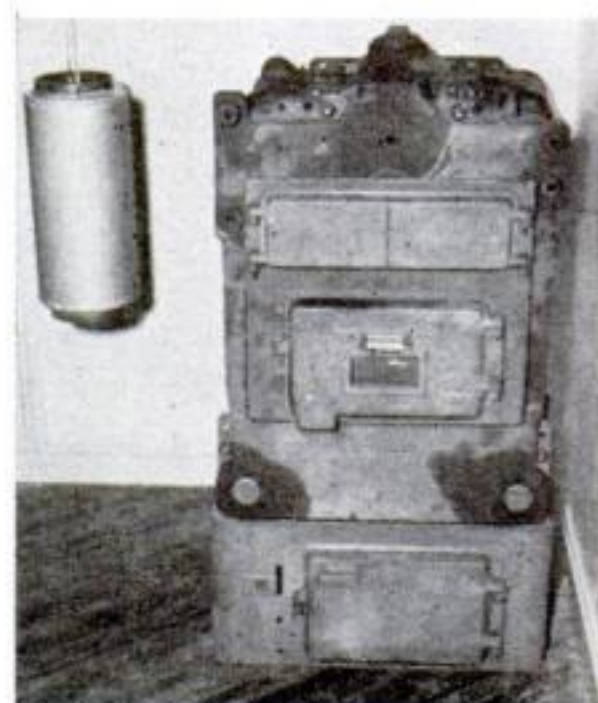
NO MATTER what kind of house you plan for after the war—whether it's to be a cottage or a mansion—you are in for a big surprise when you talk to your heating contractor. Even if you don't intend to build a new home, there are radically changed and vastly improved heating units in the making that can be installed either in your present system or in place of it.

Already announced is an anthracite furnace that you can almost carry home under your arm; it is completely automatic and occupies a space of only 2' by 2' by 3'. For soft-coal users, a revolutionary new smokeless stove with a magazine-type feed is soon to be on the market. Gas has been utilized for air conditioning, with the manufacturers ready to offer a winter-and-summer system that warms the air in cold weather and cools it in hot, while another system has a compact, vertical, small-home heater that can be tucked away in a hall closet. An electric unit, working on the reverse-cycle refrigeration principle, has been developed to extract heat for the

New ideas of combustion are embodied in a furnace that looks like a length of pipe. Below, a space heater embodying the same principle set up in a testing laboratory



Here is how the furnace works. Coal is fed in by the worm A and burns at B, ash being pushed out at the end. Water heated in the jacket C is pumped in at D. Air pulled through by a fan E speeds combustion. A complete furnace can be set up in a 2' by 2' by 3' space in contrast to that needed for the old furnace shown at right. Anthracite Industries, Inc., did the research



Shovel Drudgery

PROMISE MORE COMFORT AND AUTOMATIC OPERATION AT LOW COST

Better ways of using fuel are planned to squeeze every B.T.U. out of coal, coke, gas, and oil. New units convert coal into coke inside the fuel magazine and then burn it in the firebox with intense heat.

Some of the equipment may appear to be expensive; other types will be surprisingly low in price. A few of the systems may be practical only for large homes where the overall cost of construction will keep that for the heating plant within a reasonable percentage. Yet it may be entirely possible to install complete equipment in a cottage-type house for under \$100.

For all varieties of equipment, the trend is decidedly toward conservation of space and fuel, elimination or simplification of moving parts, and more efficient and more automatic operation. All of which points to lower operating costs regardless of initial investment and, what is equally important to most of us, the end of coal-shovel drudgery.

Working from entirely new combustion principles, scientists sponsored by Anthracite Industries, Inc., have developed from eight years of research a midget hard-coal furnace that will occupy a space of only 2' by 2' by 3' and is completely automatic. It is self-fed by a continuous screw and discards ash at the far end. The firebox is simply an 18" length of pipe 4" or 6" in diameter, depending on the size of the house to be heated.

There is none of the secondary heating area found in most furnaces; all combustion takes place in an area about 4" long. Only a small amount of coal is ignited at one time, but it burns at a furious rate, assisted by air drawn through the chamber by a suction fan. Heat is carried away rapidly, too, by a small electric pump circulating water through a 1" jacket to pipes leading to the radiators. Coal is fed constantly into the combustion chamber by a worm that keeps raw coal, burning coal, and ashes moving slowly toward the end where the ashes drop out. Rapid convection of heat and complete thermostatic control hold the actual temperature in the firebox so low that clinkers do not have a chance to form, according to the anthracite association, and only pow-



Panel or radiant heating of a home is done through a system of heat-conveying pipes under the floor, as shown by this demonstration model. Heat is uniform in all parts of a room

dered ash is delivered into the ash receptacle. A 4" pipe can carry off smoke and fumes, eliminating the necessity of a conventional chimney.

Only the basic burner has been developed by the anthracite association. This is being turned over to the manufacturers of heating equipment throughout the country and will be adapted to their individual designs. The combustion principle can be applied to hot-water, steam, and hot-air systems equally well. Installation can also be made in existing equipment, thus utilizing the heat-circulation system already present in an old house. Raw coal can be fed to the worm from either a hopper or a self-feeding bin.

The same combustion principle, not confined to central heating, has already been adapted for use as a space heater. In this unit the pipelike furnace is turned vertically and the coal is fed to the fire pot by gravity instead of by a power-driven worm. A magazine holding 100 lb. or more of coal is provided at the top so one loading can



For soft-coal users, the Bituminous Coal Institute has developed a smokeless burner that consumes gases and smoke, will hold a fire for a day or more on one charge, and will heat a four or five-room house

take care of the heating problem for a day or more without further work or attention. The space heater is also controlled by a thermostat that stops and starts the suction fan to regulate the rate of burning.

There is equally revolutionary equipment ready for the user of soft coal. The Bituminous Coal Institute has just announced a new smokeless heater, born of its own research program in which 27 stove manufacturers co-operated. Here again a new combustion principle was evolved to provide an ample supply of air at the right points, a series of high-temperature refractory flues, and a path of travel for the gases that causes them to burn away, thus not only eliminating smoke, but also effectively recovering a much higher percentage of the heating value of the coal. A saving of as much as one third in the fuel bill is claimed as a result of employing the principle, to say nothing of the relief from smudge in the house and over the neighborhood.

The soft-coal heater is equipped with a magazine feed designed to take a load that will feed the firebox for a full day or longer. Regulating apparatus makes it possible to control the rate of coal consumption and the heat from the stove.

Called a bungalow furnace because one unit will effectively heat a house of four or five rooms, the heater will burn any type of bituminous coal, even low-cost unscreened run of the mine. Accent has been on heating stoves, but actual development of designs that will reach the market is in the hands of

the 27 stove manufacturers who helped to finance the research, and it is highly possible that some will come out with central-heating plants based on this principle. A streamlined and ultra-modern kitchen range, incorporating the same combustion principles, has been built for use with either coal or wood.

Another development that holds promise is a down-draft burner for the smokeless combustion of soft coal. This was recently announced by scientists at the University of Illinois. The burner fits into the furnace combustion chamber where it can be fired through the door. A hollow baffle divides it into two chambers and admits air that helps in the burning of smoke and gases.

At Ohio State University, engineers have constructed ceramic heaters employing mostly hollow tile made by the careful blending of raw clays. In these ceramic heaters, coal is reduced to coke within the stove before it is ignited by means of convector passages that impart heat to the charge in the magazine. Ceramic coal ranges are also being made.

Automatic feed for coal and coke furnaces is undergoing important changes. While the hopper-type feed will continue to be popular, especially where one charge can be made to last for several days, there are completely automatic stokers that feed themselves directly from the bin. One such stoker consists of a rakelike arm turning constantly in the bin and raking coal toward the center and toward a worm that catches it and feeds it into the furnace. Others are made possible by simple changes in bin construction such as building in a funnel-shaped bottom that will allow gravity to drop the coal into the worm or other contrivance for conducting it to the furnace. Several such bins have been developed by the Anthracite Fellowship and the Mellon Institute of Industrial Research and are being offered to the trade. Various sizes of coal have been used in automatic stokers, some of which blow coal dust through a jet so it burns something like oil, and some even powder the coal in their mechanism.

The makers of oil-burner equipment have long been at home with automatic heating, and many efficiently designed furnaces had

been put on the market before the beginning of the war. Now that new heating characteristics and new blends have been brought out in fuel oil through war and other research, oil-burner mechanism is being adapted to utilize them with increased efficiency. The result for the home owner should be lessened oil consumption and greater economy.

New orifices mixing the proper proportion of air and gas—some of them not requiring adjustment after being installed—hold promise for increased efficiency in gas-burning automatic furnaces, and improvements in the design of the furnaces themselves are expected. One new gas furnace is a compact vertical heater that is really an air conditioner. Its vertical design reduces the floor space required for installation and makes it especially suitable for small homes, where it may be housed in a hall closet or set up in the kitchen, attic, or open hallway. Cold air is drawn into the furnace and filtered, heated, and humidified before being circulated by a large-capacity blower-type fan.

In the field of air conditioning for both summer and winter, gas units have been developed for warming and humidifying the air in cold weather and for cooling and drying it in warm weather. The latter is an application of the same principle employed in refrigeration by gas. Ducts used for hot air in the winter serve for cool air in the summer. As in other air-conditioning systems, the air is filtered during its passage through the conditioner. The refrigerant used is simply water.

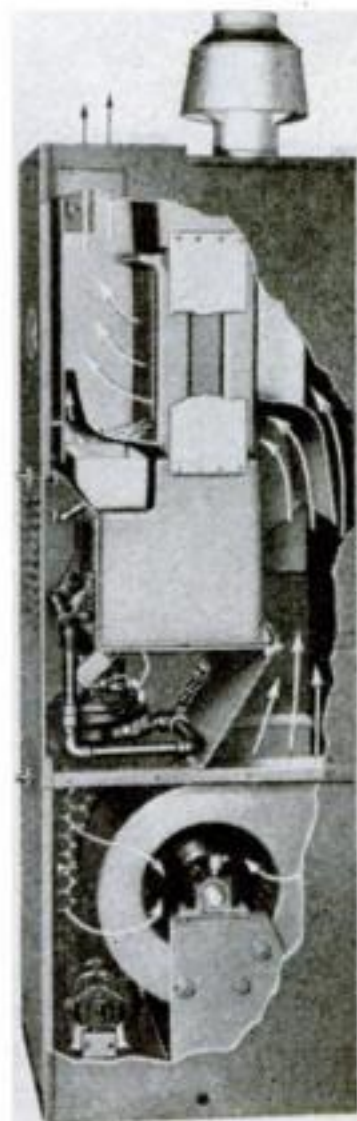
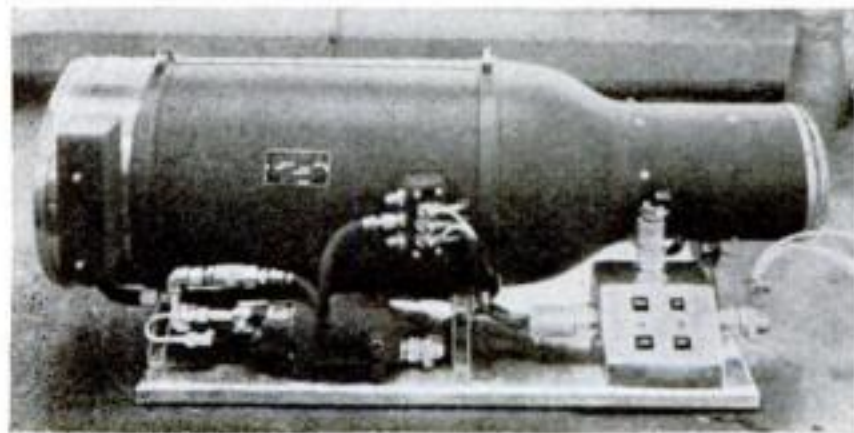
Another development in air conditioning employs the principle of compression-type refrigeration in a unique way to give heat when needed as well as cooling. Known as the reverse cycle method, it has been used in commercial buildings and it is also adaptable to residences. Its principle is that of the common electric refrigerator. Just as the compression and expansion of a refrigerant

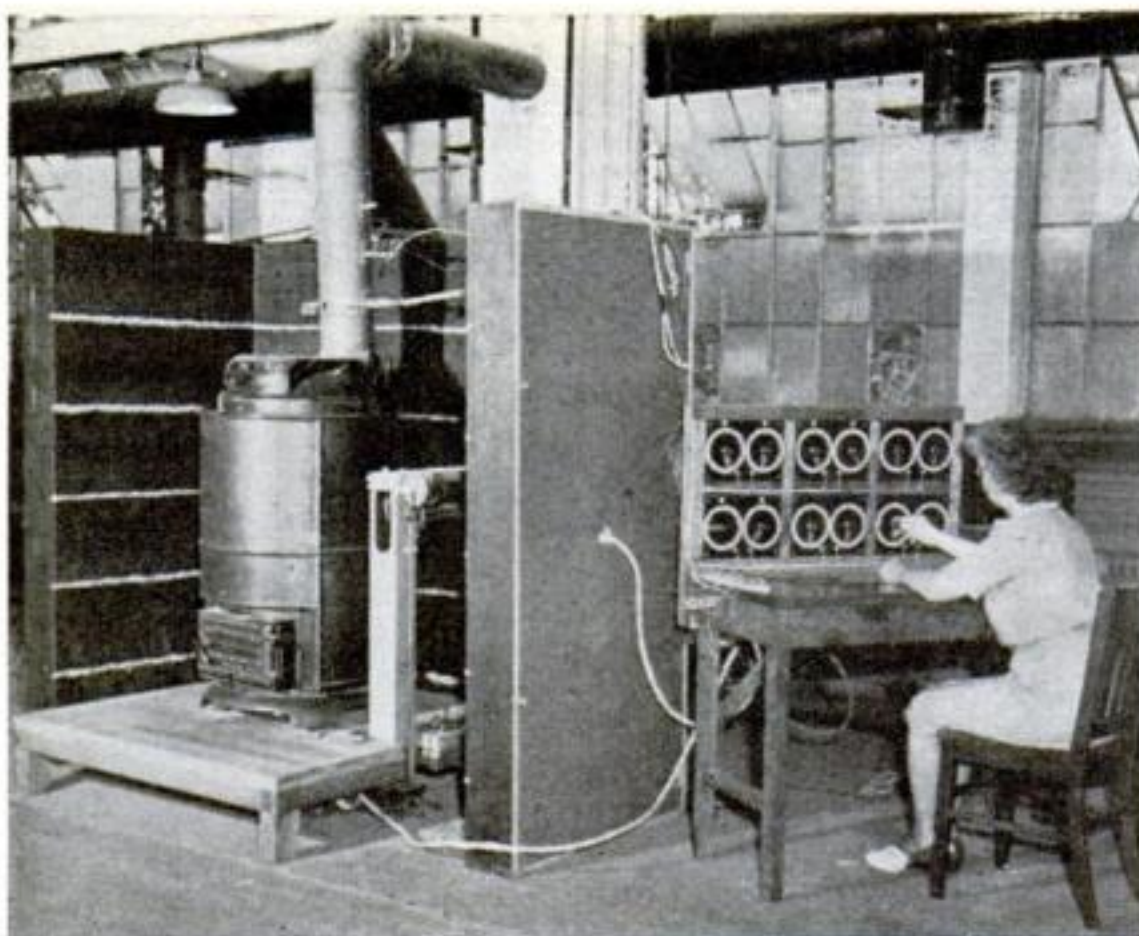
results in a transfer of heat from inside a refrigerator to the air outside it, so a larger system transfers heat from a house to the out-of-doors. The reverse cycle comes into operation in the winter when, strange as it may seem, heat is extracted from the frigid outdoor air and released inside to warm the house. This is possible because heat is present at all temperatures above absolute zero, or -273 deg. C. Normally, however, heat flows from a warmer area to a colder. To reverse this flow and transfer heat from outdoors to build up a higher temperature indoors, energy must be expended. This energy is in the form of electricity necessary to run a motor and drive a compressor. There is still a bill to be paid for heating the house, but what is purchased is the electrical energy necessary to transfer heat already existent to a place where it will be useful.

In some installations, heat is extracted from the water in a well near the house, which would normally be warmer in winter than the atmosphere.

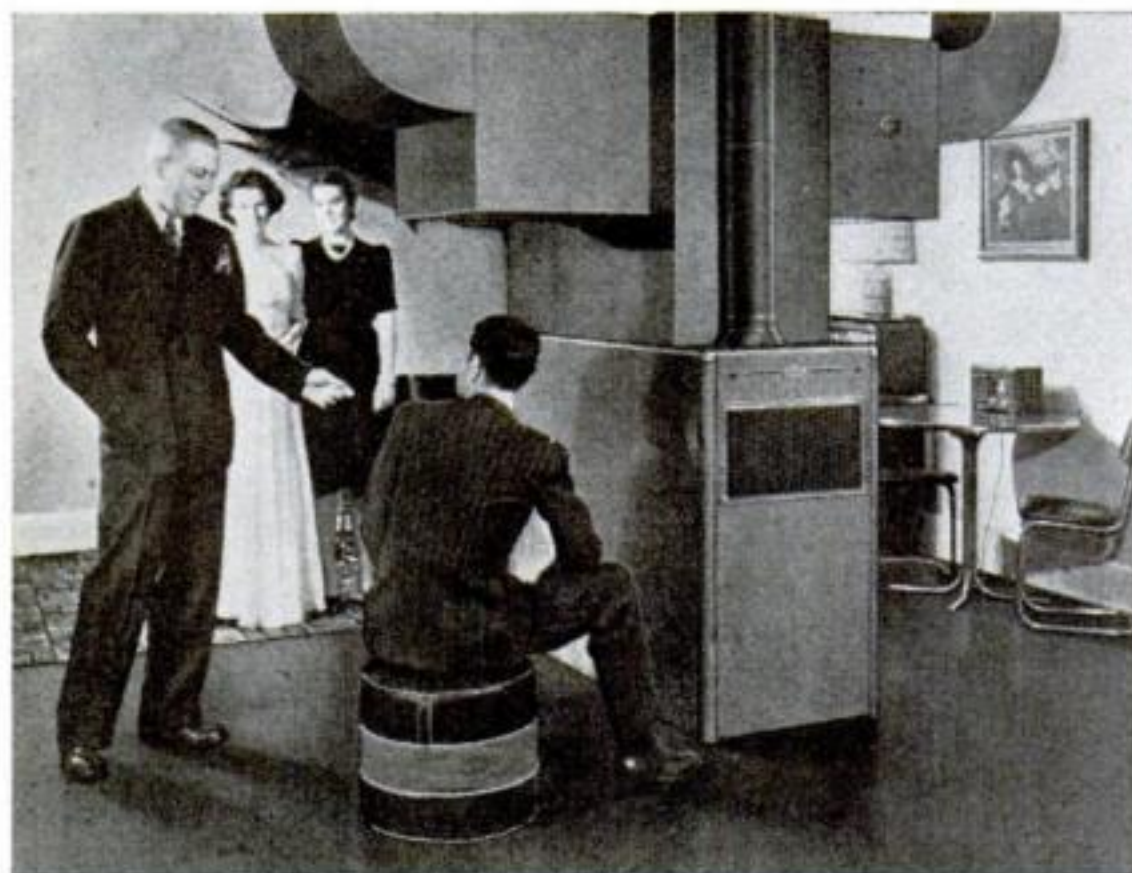
Improvements are being made in the circulating systems for both hot water and steam as well as for hot air. With the use of small electric pumps, a quicker response to demands for more heat is possible. Smaller boilers, pipes, and radiators may also be used when the heating agent is rap-

"Vest-pocket" heaters made by Stewart-Warner for stratosphere warplanes may well be adapted for home use. One is shown below. The vertical gas-fired burner shown at the right is an air-conditioner built by Bryant for small homes. It occupies so little floor space it can be installed in a closet





Heating characteristics are checked by means of thermocouples at various heights. The stove is mounted on a scale to show loss in weight as coal is consumed. Below is the new Servel gas-fired winter-and-summer air conditioner that works on the principle of the gas-operated refrigerators. It is ready for postwar houses



idly circulated. Only one main pipe is needed to carry water to radiators and back when special valves are installed throughout the system to give each radiator its proper share.

A large variety of thermostats will be offered for efficient control of heat both in the newly installed and existing systems. Some are designed to give zone control, that is, a different temperature in different parts of the house, such as the living room and dining room, kitchen and service section, and the sleeping quarters. This requires several thermostats actuating valves in various

parts of the system. Another idea is an outside thermostat that anticipates the need for more or less heat before a change in weather is felt inside the house.

One method of heating homes that was gaining favor before the war is panel or radiant heating, which does away with radiators and registers and makes use of a network of pipes laid under the floor, or even in the walls or ceiling, if preferred. The radiating surface is so large that hot and cold spots in a room are eliminated and the transfer of body heat to cold walls is materially reduced. Radiant heating may be used with any type of fuel or furnace.

Something entirely new in home-heating plants may come from wartime development of small, extremely efficient heating for stratosphere warplanes. The fuel now used is gasoline, but the same heating principle is being tried with gas and fuel oil. An electric motor drives air through the unit at high velocity.

Solar heating as a supplement to furnace heating is a method of at least cutting down on the fuel bills. All that is necessary is a great deal of glass on the south side of the house. With the development of insulated glass consisting of double panes enclosing a dead-air space, this method becomes still more practical, since the insulation provided prevents the escape of heat from the house while still allowing it

to enter. This may seem impossible at first glance, but actually the sun's rays, which are radiant heat, penetrate the insulating glass, while heat convection to the outside from within the house is blocked. Wide eaves are required with this type of construction. They must be designed to admit the sun's rays during the winter when the sun is low in the sky, but to intercept them in the summer when the sun is high.

Infrared electric lamps have been talked of also for home heating, but their use is best as a substitute for the familiar reflecting heater that warms local areas.

Hydrogen

... FIRST OF THE ELEMENTS

By KENNETH M. SWEZEY

WHEN hydrogen gas is burned in air, the reaction of *fire* magically produces *water*! Ordinary water that we drink or bathe in is nothing but an oxide of hydrogen— H_2O , the commonest formula in the catalogue of chemistry. The name *hydrogen* itself means "water producer."

Although seldom found free, hydrogen is an important and abundant element. It constitutes one ninth of the weight of water and two thirds of its volume, and it is present in all acids and bases. Compounded with carbon, it forms a vital element in all animal life and plant life and in most substances produced by them. It is present in all natural-gas and petroleum products. Flames of incandescent hydrogen a third of a million miles high have been known to burst from the sun's chromosphere.

Pure hydrogen is invisible and odorless, and it is by far the lightest of all elements. Its lightness would make it the most efficient gas for dirigibles and balloons except that it is dangerously inflammable, and for this reason the next lightest gas, inert helium, is used instead where it is available. Mixed in a blowtorch with oxygen, hydrogen makes one of the hottest flames known. Bubbled through liquid oils in the presence of a catalyst, hydrogen changes them into solid fats employed in cooking and soapmaking and for lubricants (see P.S.M., Jan. '43, p. HW 504).

That water contains 2 parts hydrogen and 1 part oxygen can be shown by decomposing water in apparatus that can be set up in a few minutes. Invert two large test tubes of water in a large glass dish of water in such a way that the test tubes will contain no air. Then connect three or four dry cells in series to supply current to two carbon electrodes (they may be taken from flashlight cells) mounted so one projects upward into each tube. That part of the wires below water should have a sealing-wax or paraffin coating to protect them from electrolytic action. The water is made conductive by stirring in 1 part sulphuric acid for each 15 parts water after the apparatus

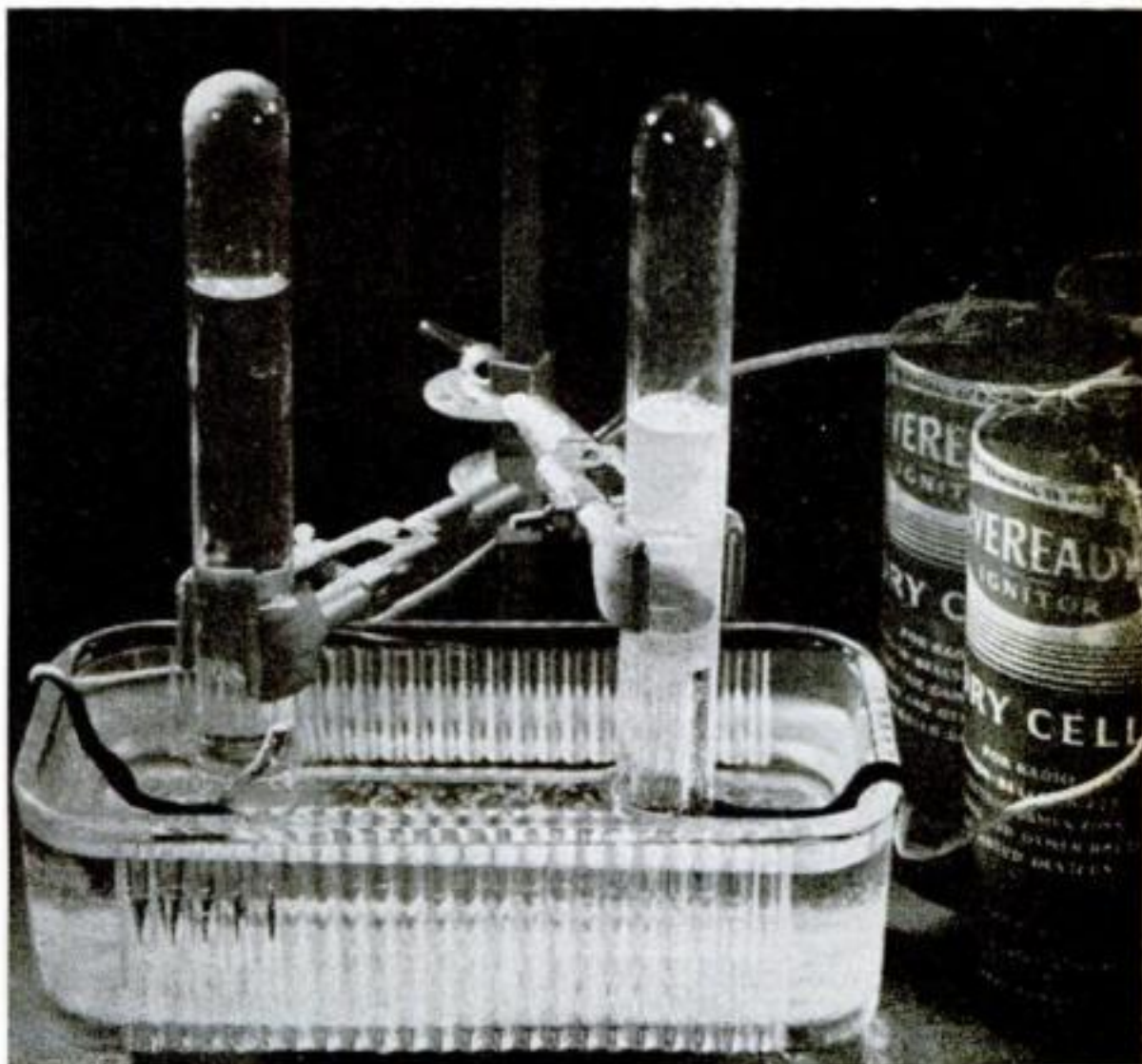
has been set up as shown in the photo below.

As soon as the battery is connected, gas bubbles will pour up from the electrodes, displacing water in the test tubes. Those from the negative electrode will be tiny hydrogen bubbles rising rapidly, while those from the positive side will be large bubbles of oxygen produced less frequently. It will be easy to see that the hydrogen formed is twice the volume of the oxygen.

When the hydrogen test tube has been completely filled, it may be removed, still inverted, and a match applied to the open end. The gas will burn quietly with a hot blue flame.

A much easier way to produce quantities of hydrogen in the laboratory, however, is to displace it from an acid by means of a metal. Dilute hydrochloric or sulphuric acid and zinc are generally employed. Use mossy zinc or zinc scraps from an old battery, since acid does not act rapidly on pure zinc, and cover a small handful of the metal with water in a 250 or 500-ml. flask. You may add a few drops of dilute copper sulphate to aid the reaction. [Turn the page.]

To show water is 2 parts hydrogen and 1 part oxygen, current is passed through water containing a little sulphuric acid to free hydrogen at the negative electrode and oxygen at the positive





Hydrogen is generated by pouring either sulphuric or hydrochloric acid on zinc in a flask set up as shown. It displaces water in an inverted test tube



Poured upward from a jar into a container balanced on a beam, hydrogen demonstrates its buoyance by lifting that side of the balance. It is the lightest of gases

The flask should next be stoppered tightly with a two-hole stopper through which are pushed a bent delivery tube and a thistle tube that reaches below the surface of the water. Connect the delivery tube with another bent tube leading below the water in an improvised trough, as shown in the photo at the left above.

Then generate your hydrogen by pouring concentrated acid carefully through the thistle tube until a vigorous reaction with the zinc begins. *CAUTION: If more acid is added later, be sure no air bubbles are carried down the thistle tube, or, better still, don't add more acid!*

To catch the hydrogen gas, fill several test tubes or jars with water and invert each in turn over the water trough, for hydrogen is collected by upward displacement. Let the gas bubble into the tubes until the water is completely displaced. As each is filled with gas, take it from the trough still inverted, slip a glass plate over the mouth, and leave it inverted.

You can demonstrate the lightness of hydrogen with a simple balance made of sticks and wire. Suspend a large cardboard container open-end down on one end of the balance beam and balance it exactly with weights on the other end. Then turn a jar of hydrogen up under the cardboard container. The gas will rise and lift that end of the balance beam.

Although hydrogen burns readily in air, it will not support combustion, as can be shown dramatically with a jar of the gas and a match.

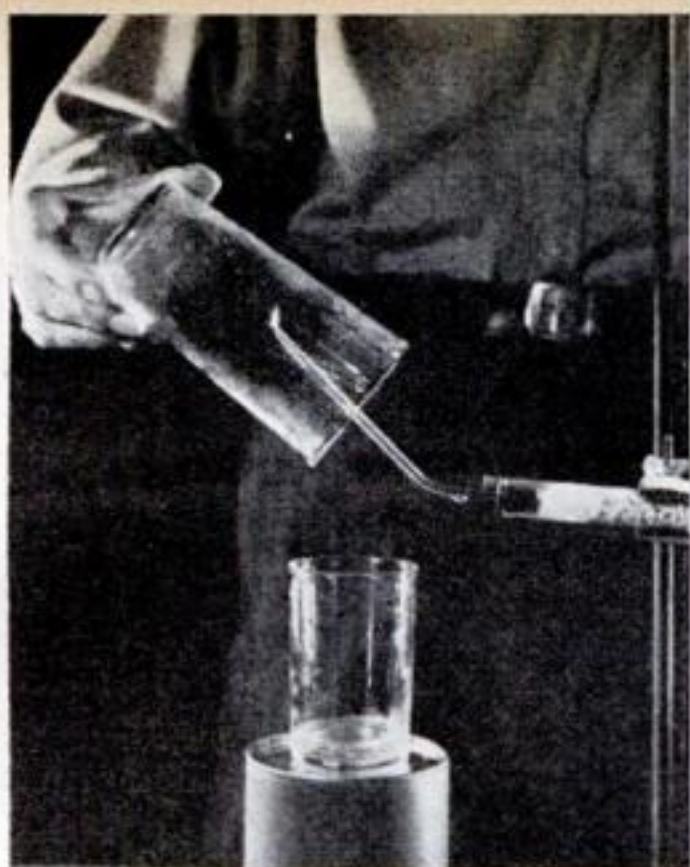
Support the jar upside down on a clamping stand or with tongs to keep from burning your hands, and introduce into the opening a lighted match held in the end of a glass tube. The gas will light at the mouth immediately, but the match itself will be extinguished if pushed well into the jar. Withdrawn again, the match will be lighted by the flaming gas at the mouth.

Hydrogen is highly explosive when mixed with air, and for that reason it is imperative that it be handled with care. Read carefully and always follow the precautions on the facing page. After that you can burn hydrogen in air to prove that it produces hydrogen oxide or, in common words, plain water. Connect a drying tube containing anhydrous calcium chloride to the delivery tube of your hydrogen generator, and to the other end of the drying tube connect a bent glass tube drawn out on its free end to a jet.

Never attempt to light the gas from the jet until you have tested it to make sure the hydrogen is unmixed with air. To do this, connect a rubber tube over the jet, lead it to the water trough, and collect a test tube of the gas as before. Ignite the gas in the test tube, and if it burns quietly it is safe to light at the jet. But if it explodes even slightly it contains air, and the jet must not be lighted until more gas is generated to force out the air and another test tube of it is tested. A further safety measure would be to wrap the generating flask loosely with a towel to catch the pieces of

Toy balloons can be inflated from a bottle of dilute acid and zinc. Hydrogen is here passed through a drying tube

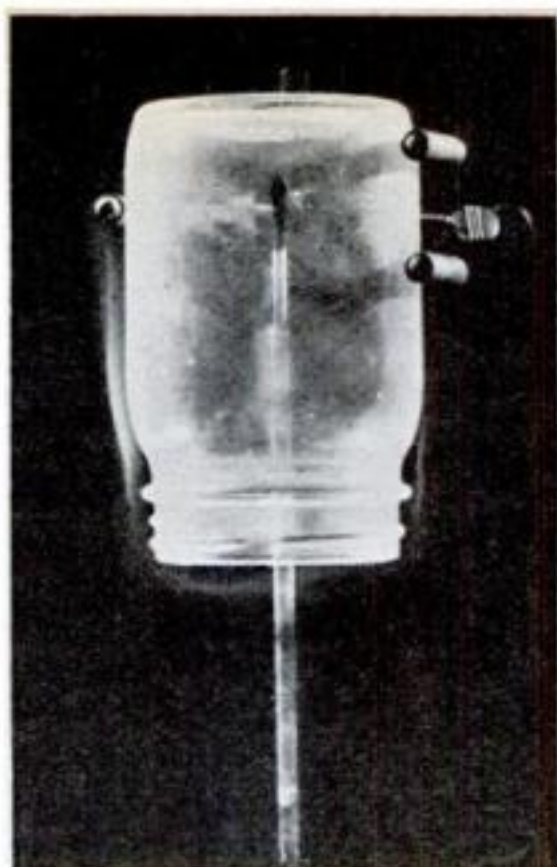




To prove that water is made by burning hydrogen, hold a cold tumbler over the flame. Water condenses on the inside



Bring a lighted match up to a jar containing hydrogen, and the gas will ignite . . .



. . . but push the match inside and its flame will be put out although the gas still burns

glass if the flask should accidentally break.

After the gas has been proved pure, light the jet. If a metal or ceramic jet is used, the flame will be an almost invisible blue. A glass jet may impart a yellowish tint because of the sodium in the glass. Now hold a cold tumbler or beaker over the flame, and drops—which can be shown by tests to be pure water—will collect inside.—

If you would like to show the remarkable lifting power of hydrogen and inflate toy balloons with it, a special generator for the purpose can be made by fitting an ordinary 8-oz. bottle with a one-hole stopper into which is pushed a drying tube containing

calcium chloride. Put a few pieces of mossy zinc in the bottle, cover them with dilute hydrochloric acid (about 1 part acid to 4 parts water), and add a few drops of copper sulphate solution.

Tie a balloon to the open end of the drying tube and hold the stopper to keep it from popping out while the balloon is being inflated. When you remove the balloon, tie its neck to prevent the gas from escaping. A small balloon will lift itself and at least several paper clips. The approximate lifting power of the gas is about 1.2 grams per liter since hydrogen weighs 0.09 grams per liter and air 1.29 grams.

Danger—HIGH EXPLOSIVE!



MIXED with air, hydrogen is dangerously explosive, but it is an interesting and important gas made in all school and most home laboratories, and it is absolutely safe when handled properly. Accidents from hydrogen explosions are almost invariably caused by carelessness, and they are inexcusable. If you learn the following simple

rules and observe them faithfully, you will never have cause to worry.

1. Don't generate large quantities of the gas. A 500-ml. flask should be the largest used in a home lab.

2. Make all connections gastight.

3. Never ignite hydrogen issuing from a generator until a sample collected in a test tube has been burned with a quiet flame.

4. At other times, never allow a flame near the generator.

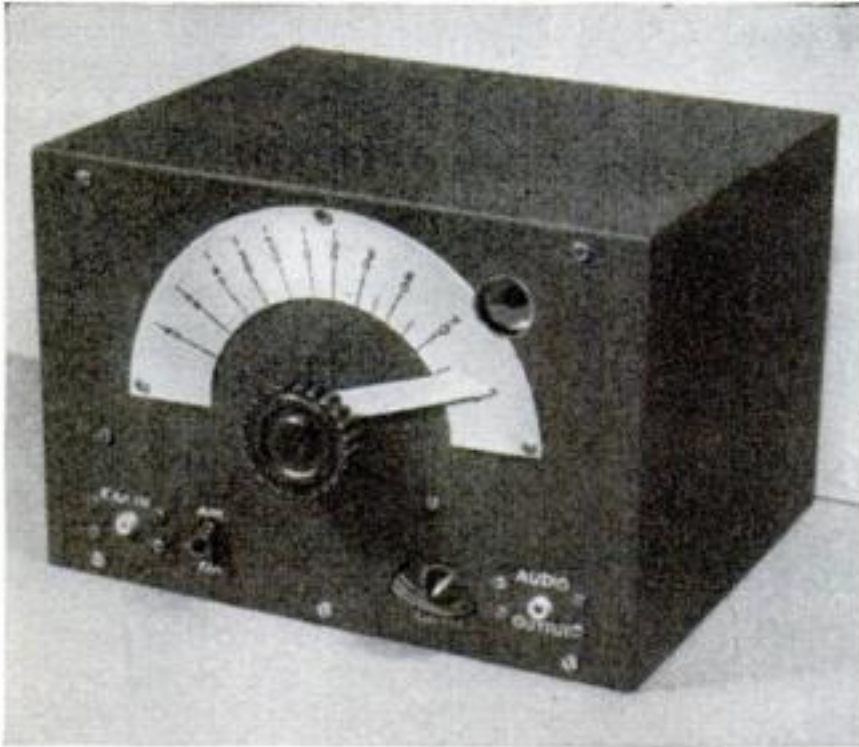
5. It is best not to add a second charge of acid to a generator. If you must, be sure no air bubbles are carried through with the acid.

6. To prevent a flash back, extinguish a hydrogen flame with a piece of wet paper or a wet cloth.

7. Don't try to produce hydrogen-air explosions in anything but a test tube or other small straight-sided vessel.

8. Wrap the generator loosely with a towel to catch glass if it breaks.

T.R.F. RECEIVER HAS



Housed in a trim cabinet, the original receiver had an extra input enabling it to be used with an FM tuner. A tuning eye is located beside the dial

By JOHN CAMPBELL, JR.

COMBINING automatic volume control and a tuning eye with excellent fidelity, this tuned-radio-frequency receiver will give top-notch local reception when connected to a good amplifier. It will not tune with the critical sharpness of a superheterodyne, but is selective enough for all ordinary purposes. For use with a high-quality A.F. amplifier, or a high-fidelity woofer-tweeter system, the T.R.F. circuit is hard to beat. Whereas superheterodyne receivers can be made to give high fidelity only by elaborate and critical adjustments,

this T.R.F. circuit is simple enough for the beginner to assemble.

Aside from the tuning eye, the circuit requires only three tubes. It can be connected to draw its power from the audio amplifier used with it, or may be built with a separate power pack. The hookup shown uses standard 6-volt tubes; if others are substituted, condenser and resistance values may have to be revised to suit.

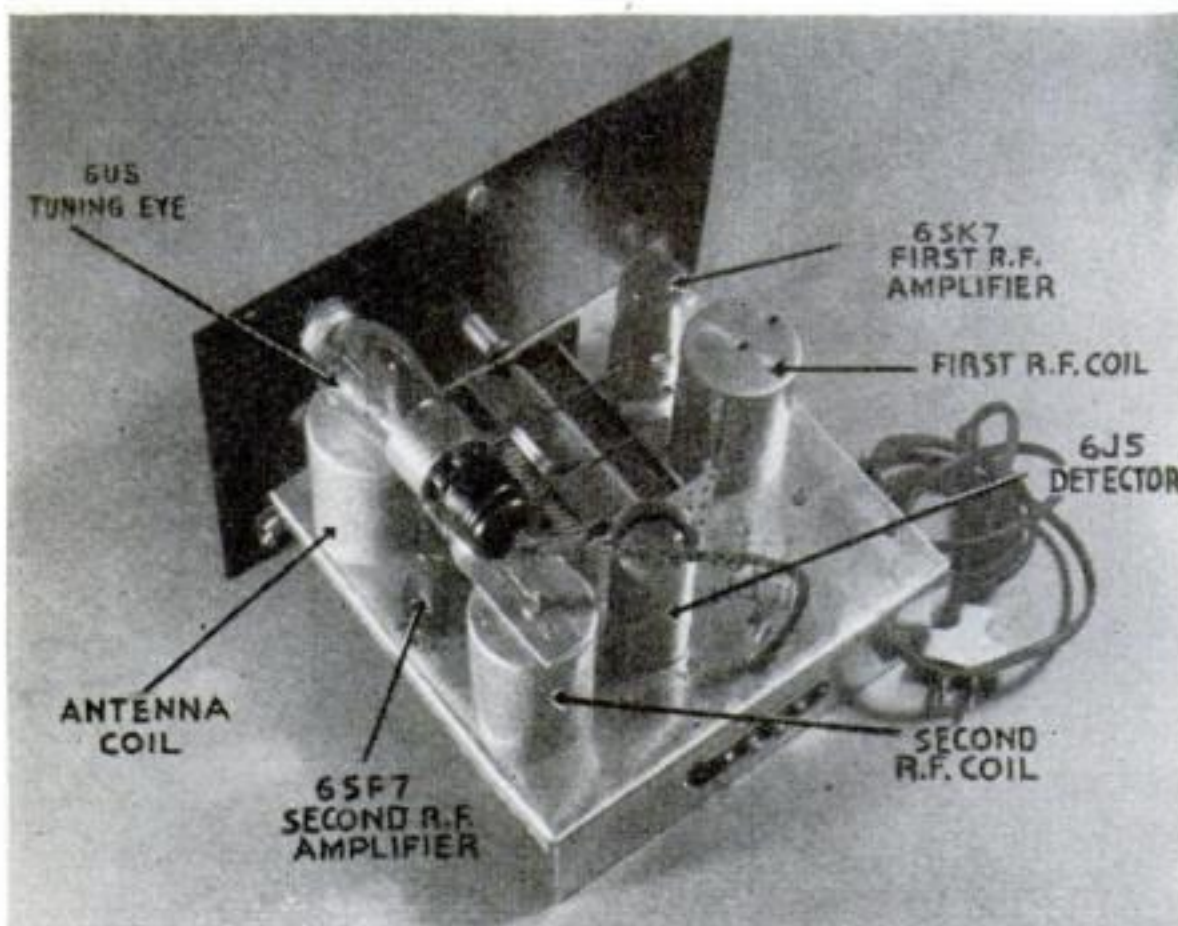
A straightforward two-stage T.R.F. amplifier is followed by an infinite-impedance detector, which gives excellent quality without loading the tuned circuits. The 6SF7 tube used as the second amplifier is essentially a pentode identical to the 6SK7, plus a detector diode. This diode is condenser-coupled to the plate of the pentode section to generate the A.V.C. voltage. Since the plate coil section of an R.F. transformer is not tuned, the diode load does not appear on the tuned circuits.

As shown in one of the photographs, the antenna coil, which feeds into the grid of the 6SK7, is across the chassis from it. The first R.F. coil, which feeds into the 6SF7 grid, is across the chassis from this tube, but next to the 6SK7, the plate of which feeds into it. This is sound layout practice. The grid of the 6SK7, as shown in the drawing, is connected to the stator plates of the tuning condenser. Gang condensers have connecting lugs on both sides of the stator frame, so the grid end of the antenna coil is connected by a very short lead to the stator lug on that side, and the 6SK7 by another short lead to the stator lug on its side of the chassis. The same is done with

the first R.F. coil and the 6SF7. Thus the stator plates constitute most of the grid leads. Because the coil associated with each plate circuit is near the tube involved, plate leads also can be kept to minimum length.

Keep all other R.F. leads as short as possible and well protected from each other to avoid excessive feed-back. It's a good trick to use bright-red hookup wire for them, and to place the various by-pass condensers so that they will help block feed-back.

Parts are laid out to minimize R.F. feed-back. All coils are shielded. Both plate and heater current is drawn from the A.F. amplifier used with this tuner



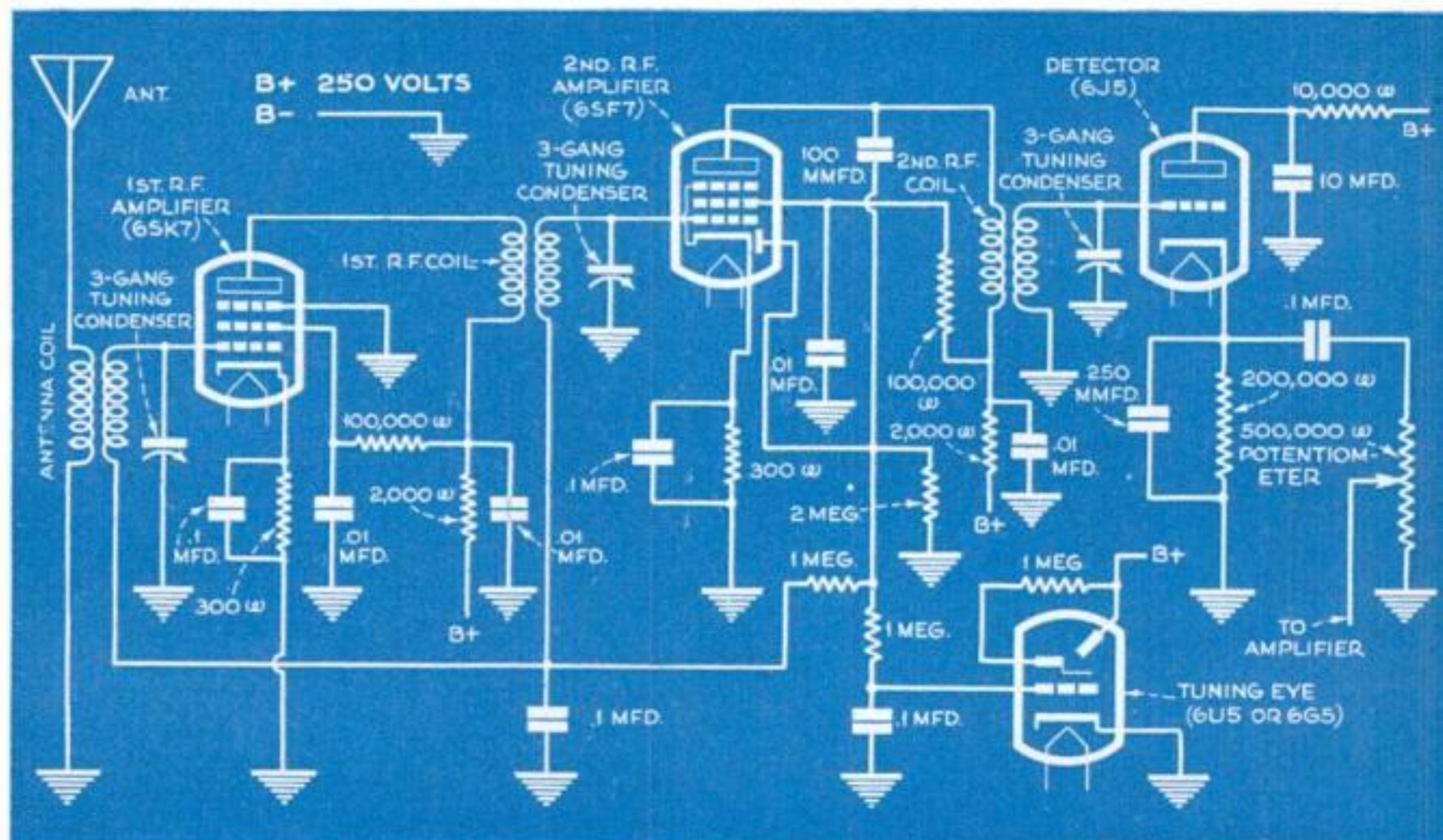
AUTOMATIC VOLUME CONTROL

Slight feed-back can be tolerated and is even desirable. When plugged in, the set should be somewhat "busy" with no station tuned in, since a very small feed-back tends to greatly increase sensitivity and improve selectivity. But do not expect critical tuning; the circuit is intended for high-fidelity reception, and must therefore pass the full 10,000-cycle band width of the transmitter with nearly uniform response.

In selecting parts, be sure to use a

matched set of antenna and R.F. coils. Otherwise a slight difference between them might mean, for example, that with the antenna circuit tuned to 1,100 kc., the first R.F. stage might be tuned to 1,050 and the second to 1,200 kc., even though all trimmers were adjusted so that the three circuits tune simultaneously to 1,500 kc.

A short indoor aerial will suffice for local reception. With an outdoor aerial, selectivity will be somewhat poorer.



CHOOSING RADIO RESISTORS

[ELECTRICAL]

A COMMON means of reducing voltage at a desired point, or of limiting current draw to a safe value, is to insert a resistance in the circuit. This is usually connected in series with the power source and whatever device or apparatus is to be so controlled.

Two conditions must be met in choosing the right resistor: it must have the correct resistance to cause the required voltage drop, and it must have enough current-carrying capacity to remain reasonably cool in operation.

The resistance is calculated by the formula $R = E \div I$, where R is in ohms, E in volts, and I in amperes. If the current is in milliamperes, R will be in thousands of ohms.

EXAMPLE: A resistor is needed to drop a 300-volt plate supply to 100 volts for the screen grid of a 6SA7 tube. Thus 200 volts must be dropped across the resistor. A tube manual lists the screen-

grid draw as 11 milliamp. Dividing 200 by 11 yields 18, which being in thousands of ohms indicates a resistor of 18,000 ohms. In practice 20,000 ohms would be close enough.

The necessary current-carrying capacity or wattage rating is given by the formula W (watts dissipated as heat) $= E^2 \div R$. Squaring the voltage drop ($200 \times 200 = 40,000$) and dividing by the resistance (18,000) gives 2.2 watts; however, if we use a 20,000-ohm resistor, it need be rated at only 2 watts.

EXAMPLE: The screen of an R.F. amplifier tube that draws 2 milliamp. is to be supplied with 180 volts from a 300-volt source. The voltage drop across the resistor must therefore be 120 volts. Dividing 120 by 2 gives 60, which again is in thousands of ohms. Squaring the voltage drop ($14,400$) and dividing by resistance (60,000), we find the resistor should be rated at .24 watts.

POPULAR SCIENCE MONTHLY SHOP DATA

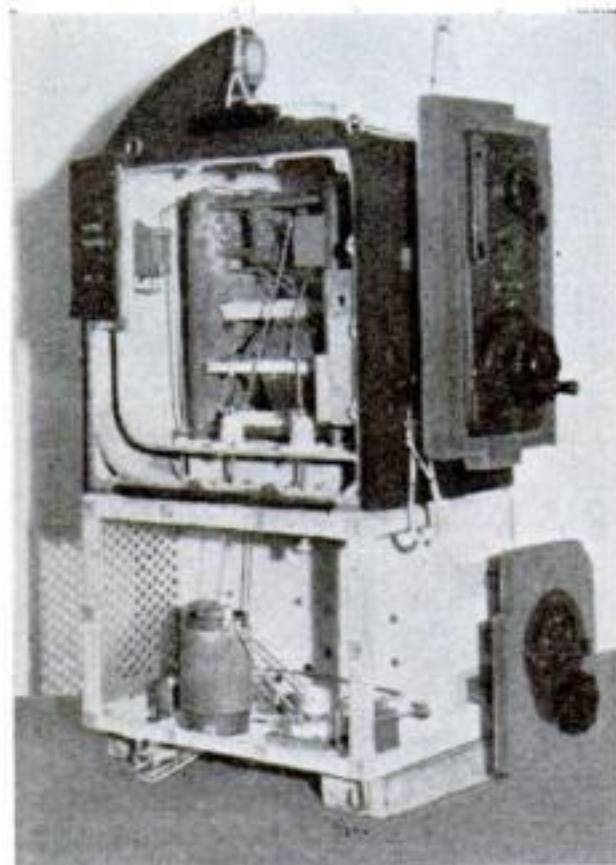
radio ideas

WALKIE-TALKIES have been experimentally used on the golf course, where they have proved successful in transmitting play-by-play accounts of tournaments, thus indicating a possibility of postwar use by golfers and others who would like to keep in touch with their homes and offices. The lightweight radio with attached antenna shown at the right was built by Motorola and is similar to the walkie-talkie used on the war fronts by the U. S. Army Signal Corps. Many improvements in this type of equipment have resulted from the war.



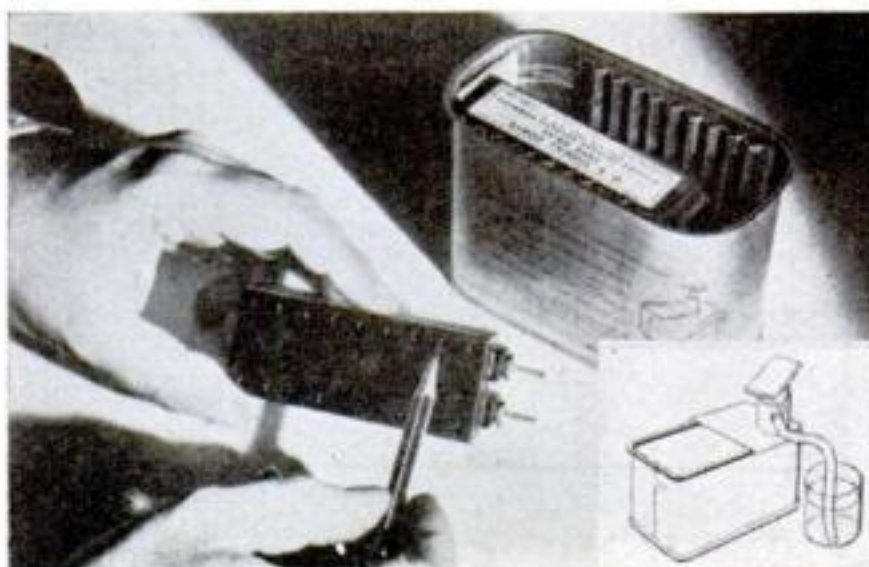
THIS MIDGET RADIO in a plywood cabinet measuring 3" by 6" by 6" was built of parts salvaged from junk heaps by Sgt. Donald Develder, of Rochester, N. Y., a member of the Coast Artillery Command stationed in the Panama Canal Zone. It has two tubes, plugs into the usual wall receptacle, has a trailing antenna, and weighs 3 lb. Eight holes in the front plywood panel let the sound through.

QUICK ADJUSTMENT OF FREQUENCY without loss of stability permits radio operators in the U. S. Navy to handle thousands of messages over a large number of channels and so escape jamming by the enemy. One frequency generator responsible for this great stride in radio is the invention of a Navy officer, Capt. J. B. Dow, and is known as the Dow electron-coupled oscillator. It combines the stability of the quartz crystal, one of which



has previously been required for each "fixed" frequency, with military requirements for a transmitter that can be quickly tuned to a number of frequencies. The Dow tuned circuit accomplishing this is really two inductance-capacitance circuits, one connected to the screen grid of a tetrode and the other (tuned to twice the frequency of the first) connected to the plate. They are coupled only by the electron stream between the grid and the plate.

VACUUM-PACKED BATTERIES, four to each container, are filled for use simply by puncturing the casing with a special tube that permits the vacuum to suck in the electrolyte, as shown in the inset at the right. The batteries, three rated at 36 volts and the fourth at 6 volts, are provided with 18 vent holes each, one hole for each cell, to receive the electrolyte. They were developed by the Willard Storage Battery Company for the armed forces.



When Fighters Turn Bombers

(Continued from page 125)

but Rommel soon began escorting them with barges on which were mounted clusters of 88's. The barges would flank the supply ships, where the masthead bombers couldn't get at them with their strafing, and after the boys had tossed their bombs, the 88's opened up on them going away. "They cut their fuses to as little as 300 feet," one of the pilots says. "We got their ships, but they got our planes." That one was solved by sending over medium bombers and fighters just ahead of the masthead attack; they came in at medium altitude and strafed and frag-bombed the barges. Then the masthead boys came in and did their stuff.

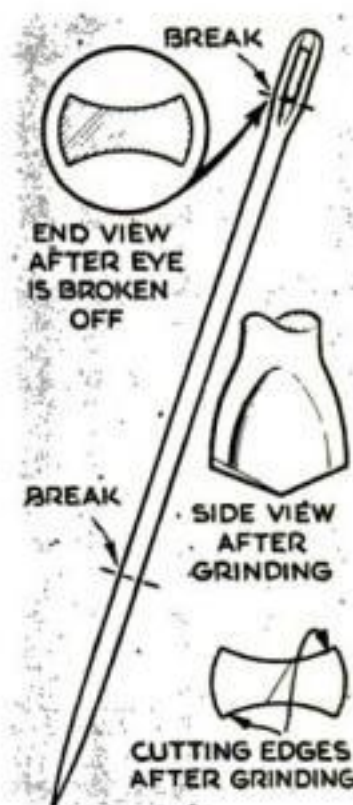
Out in the Pacific, however, our flyers discovered a hazard in their own bombs. Working below treetop level, they found that the bombs now and then would bounce as high as the plane on their first jump, and occasionally a plane's tail assembly was damaged. That was one reason why they took the skip out of skip bombing: they learned to flip the bombs onto the target directly, instead of bouncing them onto it.

That problem also was a factor in developing the parachute bomb; and it led, eventually, to what the boys call glide bombing. Glide bombing comes indirectly from dive bombing, but it is done with faster and bigger ships. It starts from 10,000 feet or higher, where the glide bomber noses over and heads for his target. His dive is at an extreme angle, and he sights on his target with the nose of his ship. But, unlike the dive bomber, he releases his bomb or bombs at about 2,500 feet, pulls out, and gets away. Properly done, glide bombing is extremely accurate, and the head-on ship presents a minimum target to antiaircraft guns.

The glide bombers use standard bombs. Down in the Pacific they also used, in some campaigns, lots of beer bottles. Any empty bottle makes a shrill whistle as it falls through the air. Bend a razor blade into its neck and it fairly screams. Some types of bombs make a noise very much like that of a bottle. So the boys took along a case or two of empty bottles, particularly when attacking Jap airfields. They dropped bottles and bombs together. And the Japs spent days looking for time bombs—that's what they thought the bottles must be. Just to encourage them, our pilots began dropping a few time bombs, too. The results were altogether satisfactory. A couple of 500-pound bombs, a case of beer bottles, and half a dozen small time bombs would immobilize a Jap airfield for days.

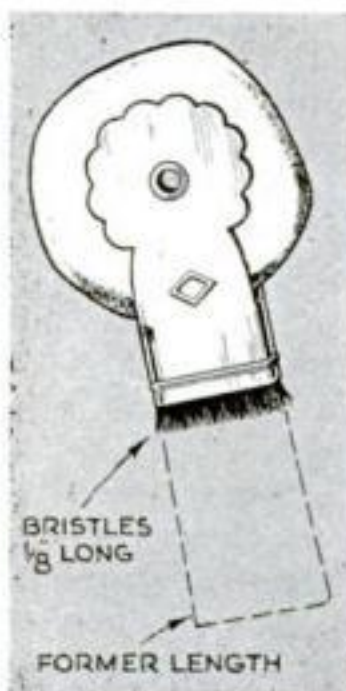
Twist Drill Made From Needle

IF YOU break your last small twist drill when you are in the middle of a job, and if purchasing a new one is inconvenient, you can make a substitute from a small needle. Break off the point and the eye, as shown. Grind down the upper or head end of the remaining piece to form two cutting edges. Chuck the shank in a hand drill. The drill thus made will be found to have good side clearance.—CPL. JOSEPH A. DESBIENS.

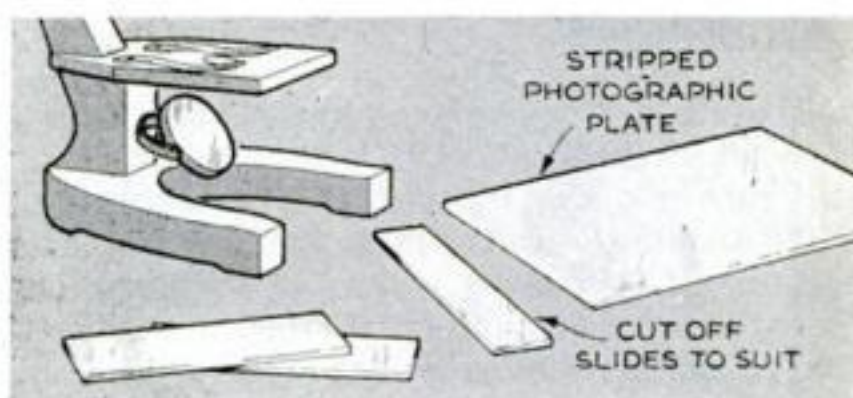


Brush Cleans Typewriter Type

INSTEAD of discarding a typewriter eraser-brush when it wears out, you can make it over into a type cleaner, similar to the one shown at the left, by cutting the bristles to about $\frac{1}{8}$ " in length. They will then be stiff enough to be used for flicking out the lint and other matter that might, if left in the type, make the copy extremely difficult to read.—J. WELSH.



Easily Made Microscope Slides



PHOTOGRAPHERS generally have on hand some old glass photographic plates. The excellent, flaw-free material from which these are made is ideal for microscope slides. Soak them in hot water to remove the emulsion; then cut them into strips that are of the proper width to fit on the stage of your microscope.—LOUIS CHIREY.

When Plane Cabins "Explode" (Continued from page 136)

The doctors know, now. They have experimented with "explosive decompression."

Scores of men have been subjected to it, some of them at simulated outside altitudes of 50,000 feet with the inside pressure pumped up to 40,000. In a fraction of a second they have been catapulted from a pressure of 2.7 pounds to the square inch on their bodies (the pressure at 40,000) to 1.7 pounds (the pressure at 50,000). They have been exploded from 10.1 pounds to 3.55 pounds. That is equal to being shot from an altitude of 10,000 feet to one of 35,000 in less time than it takes to draw a breath.

And these are the findings:

At most altitudes, explosive decompression will have no ill effects.

At extreme altitudes it *can* produce serious effects.

Unofficially, a corollary finding can well be that limitations on what the body can stand may establish an altitude beyond which human beings cannot engage in air warfare in pressurized compartments.

Experiments in explosive decompression were begun in the spring of 1943 when the Twentieth Air Force, employing the pressurized-fuselage Boeing B-29 Superfortress, was only in the planning stage. An Army major, H. M. Sweeney of the AAF Materiel Command, undertook the work. Lower simulated altitudes in airplanes flying at high altitudes meant, of course, greater crew comfort and efficiency. Above 30,000 feet, airmen had to breathe pure oxygen to stay alive. Above 40,000—if operational altitudes ever went that high—they had to breathe pure oxygen under pressure because the outside air pressure was insufficient to force it into the thoracic cavity.

Sweeney was his own guinea pig.

On the meager evidence at hand, and pending an accumulation of more precise information, the Aero Medical laboratories instructed the Materiel Command's aircraft and power-plant laboratories to stress the B-29 fuselage and build the pressurizing equipment tentatively for a pressure differential of 6.55 pounds to the square inch. The aircraft laboratories express that as "PSI."

Air at sea level is heavy. Every square inch of the body has 14.7 pounds of air weighing on it. At 60,000 feet the weight is only 1.1 pounds. So a pressure differential of 6.55 PSI at 30,000 feet would mean a pressure inside the airplane of 6.55 plus 4.4 (the pressure outside), or 10.95 PSI. For the crew that would be a simulated altitude of about 8,000 feet. A pressure differential

of 6.55 PSI at 35,000 would mean a pressure inside the plane of 10.1 PSI for a simulated altitude of 10,000 feet.

Sweeney knew he was dealing with some highly critical factors in explosive decompression. One was *aeroembolism*, in which nitrogen comes out of solution in the blood, collects at the joints, and induces excruciating pain. Another was expansion of the internal body gases. In an explosion from sea level to 40,000 feet, for instance, those gases would set up an expansion rate of 110 times a second.

Equipment was meager in the beginning. A flying suit, in which pressure could be built up and suddenly destroyed, was used. Sweeney donned it and exploded himself in a low-pressure chamber at modest differential pressures up to 35,000 feet. X-ray pictures showed that his body had suffered no damage. The tests were pushed to 45,000 feet—using, however, a differential of only 2.75 PSI to ward off the bends.

Apertures of different sizes were used to govern the time in which the pressure was lost.

When the pressure suit outlived its usefulness—it could not hold a 6.55 PSI differential—Sweeney borrowed a mockup of a P-38 fighter cockpit from the Lockheed Aircraft Corp. Gradually pressures were built up as the mockup gained "altitude" in the pressure chamber. When a 6.55 PSI differential was used at 35,000 feet with a 12-inch explosion opening, decompression occurred in 75/1,000 of a second. The expansion of body gases amounted to 3.5 times at a rate of about 47 volumes a second.

Sweeney successfully tried a 7.5 PSI differential to simulate an 8,000-foot altitude at 35,000 feet and one of 1.5 at 50,000 feet, using an opening as big as 26 inches in diameter. The explosion from an opening of that size simulated what would occur if enemy gunfire or flak destroyed the new-type "bubble" canopy on fighter planes.

Other subjects followed Sweeney. He and some of his colleagues, including flight surgeons attached to the Twentieth Air Force, were exploded at extreme altitudes in 8/1,000 of a second. Bad effects began to appear. Several cases of "bends" of rapid onset occurred. The subjects fumbled when they tried to adjust the pressure-breathing regulator. It was a bit too much for the body to take.

Maybe an extreme height exists beyond which ordinary man cannot venture. Maybe Major Sweeney has drawn a red line on high-altitude military flying.

"Get Good With the Grenade" (Continued from page 117)

grenade with a laminated-paper body also was produced. It was safer to use in the open than the Mills type, which had been designed as a defensive grenade to be thrown from cover, yet our fighters preferred the more powerful fragmentation grenade. The AEF also was supplied with a number of types of smoke, incendiary, and gas hand grenades.

The British continued to use rod-type rifle grenades throughout the war, but two French experimenters, Viven and Bessieres, produced a superior weapon which we adopted, and which, in slightly improved form, we are still using. This "V.B." grenade is fired from a short, cylindrical discharge cup, or *tromblon*, which slips over the muzzle of the Springfield rifle. The grenade is a cylinder of malleable iron, two inches in diameter and $2\frac{1}{2}$ inches long, notched on the inside to insure fragmentation. It weighs a little over a pound. A tube, large enough to allow free passage of the rifle bullet, extends through the grenade; on one side of it is the fuse assembly. A striker extends obliquely over the end of the bullet tube. When the rifle is fired, the bullet hits the striker, causing it, in turn, to hit the primer. This ignites a fuse that is timed to set off, at the end of the grenade's flight, a detonator that explodes the high-explosive bursting charge. The gases following the bullet out of the rifle barrel propel the grenade from the discharger. The normal range is up to about 300 yards and the effective radius of the burst about 30 yards.

In World War I the rifle grenade was used extensively to produce harassing fire in trench fighting, for close-in defensive barrages, and for other purposes. Some years ago, after our development of the 60-mm. mortar, which fires a $2\frac{1}{2}$ -pound projectile, our Army discontinued use of the rifle grenade as a weapon against personnel and other unarmored targets. The Marines continued to use the V.B., which, during the current war, has been highly effective in jungle fighting.

Our present fragmentation hand grenade was developed from our World War I adaptation of the Mills grenade. Instead of a high explosive, its bursting charge is grained E.C. semicolloided nitrocellulose powder. This substitution eliminates, without loss of effectiveness, the need for a detonator, and permits the shipment of grenades complete with their fuses. The cast-metal, lemon-shaped body, $2\frac{1}{2}$ inches in diameter and $4\frac{1}{2}$ inches long, is grooved like a waffle to insure good fragmentation. The fuse as-

sembly is screwed into the top of the body. The firing mechanism is a hinged steel striker actuated by a spring and held in position by a lever which extends downward along the grenade body. A safety pin, with a ring attached to it, extends through the lever and secures it to the body. Just before the grenade is to be thrown, the safety pin is withdrawn, the lever then being held in position against the grenade body by the thrower's hand. When the grenade leaves his hand, the lever flies off and the pressure of the spring rotates the striker around its hinge pin and causes it to hit a primer that is almost noiseless. The primer lights a fuse which, after burning for five seconds, fires the ignition charge of black powder. This, in turn, sets off the bursting charge.

Our method of throwing grenades has been improved as much as the grenades themselves. In World War I we adopted the Britishers' straight-arm overhand "cricket swing," which almost all baseball-experienced Americans found both unnatural and ineffective. The throwing motion our GI's are taught now is like a catcher's peg starting from a shot-putter's stance. "According to the book," a crawling bomber must rise to his knee before throwing his grenade, but Jap snipers have forced a modification of this rule, and our men have devised several ways of throwing accurately while flat on the ground. One of them is to lie on your back, use your arms to pull yourself into the position from which you want to throw, and then stretch up your arm and throw as you do a half-roll toward the target. "Better get good with the grenade," is the advice being sent home from the Southwest Pacific. "It pays in the jungle!"

Grenade throwers in the open are drilled to drop to the ground after each throw. This is a necessary precaution because the effective radius of the fragmentation grenade is so large that the thrower is in serious danger of being injured by his own weapon. An offensive hand grenade is issued for use in the open. It consists of a half pound of pressed TNT in a cardboard, fiber, or plastic body, and is equipped with the same fuse as the fragmentation grenade. Its concussion effect is dangerous over a seven-yard radius. It is very effective for the demolition of emplacements, but when our fighters go hunting Japs they prefer the more powerful fragmentation grenade.

Smoke and incendiary grenades also are issued. Smoke grenades are tin cylinders $2\frac{1}{2}$ inches in diameter and about five inches long filled with a smoke-producing composi-

tion and equipped with short-delay fuses. Incendiary grenades usually are pint-size glass bottles filled with a gasoline-base inflammable liquid, with an igniter taped to the outside of the container. There also are thermite grenades that have tin-plate shells; and a sticky grenade whose rubber-gasoline mixture ignites spontaneously when the bottle shatters on its target.

The success of German tanks in 1940 created a demand for an infantry weapon light enough to be carried and fired by an individual soldier and powerful enough to penetrate the armor of modern tanks. Our Army Ordnance Department met this demand with our new antitank rifle grenade, which at moderately short range is capable of penetrating and destroying any known enemy light or medium tank.

This grenade is fired, by means of a special blank cartridge, from a launcher clamped to the rifle barrel. The launcher, a steel tube forming an extension of the barrel, has rings milled into its outside surface. The grenade, which weighs about 1½ pounds and costs two dollars, is a cylindrical sheet-metal shell loaded with a powerful high explosive and provided with an impact fuse. Its tail section is a vaned hollow tube that fits over the rings of the launcher. Two models of the antitank grenade are used: one with a fuse that detonates only on

impact with a hard, resistant body; the other with a more sensitive fuse that functions upon impact with soft earth. Both models are used by the Army and the Marines.

Another of our rifle grenades is basically the fragmentation hand grenade, with an impact-type fuse and provided with a vaned tail assembly similar to that used with our antitank rifle grenades. We also have an ingenious grenade adapter which permits the use of the fragmentation hand grenade as a rifle grenade.

The Springfield rifle is commonly used for firing antitank grenades, and one man in each infantry and Marine rifle squad is armed with it for that purpose. A butt rest may be used, or the rifle may be fired from the shoulder—although the recoil is heavy. Ordinary ball ammunition may be used with the launcher—but not with the grenade—in place. Similar launchers made it possible to fire rifle grenades with both the Garand and the 5½-pound carbine, with which a large proportion of our soldiers now are armed.

The Germans developed grenade projectors in 1916. Present Nazi and Jap models are similar to light mortars. Newest development is the British "Piat"—a 33-pound launcher that projects a 2½-pound antitank bomb 350 yards.

Winning the War on Rust (Continued from page 130)

ture off of the metal, will not corrode even though left in the humidity cabinet for hundreds of hours. Many manufacturers of easily corroded precision parts now insist that these parts be coated with fingerprint-removing oil the instant they are finished.

Special oils may be used to remove immense quantities of moisture from machinery. Water does not cause much rust unless oxygen is plentiful in its vicinity. As you descend into the sea, the amount of oxygen in the water diminishes rapidly. Many parts of sunken ships, consequently, may not rust seriously. But when the ships are lifted to the surface, the water clinging to the metal is brought into the presence of the oxygen in the air. Rusting may then occur almost instantly if the metal is not quickly dried. This now can be done with oil.

When the *Normandie* was raised, much of its machinery was saved by promptly spraying, swabbing, and bathing it with rustproofing oil. Even though the liner had been submerged for months, only two parts of its delicate and complex gyroscope had to be replaced. Similar oil was applied to

the machinery of the submarine *Squalus*, which was later recommissioned as the *Sailfish*. The success of the salvaging operations at Pearl Harbor is credited partly to the use of oil containing rust inhibitors.

The U. S. Navy is also using antirust oils to protect inactive ships. In addition, such vessels may be dehumidified by mechanical drying machines. Six of these machines are being used on an experimental ship. Each drier contains two beds of silica gel or activated alumina to take moisture out of the air. Electric heat dries out each bed when it becomes saturated with moisture.

Improved rustproofing techniques will help raise the whole world's standard of living. Manufacturing losses may be reduced; sunken ships may be salvaged more successfully; weapons need not grow rusty for lack of use; international commerce will be facilitated, and metal can be made to do more of men's work for them even in the most unfriendly regions of the earth. For the development of rust-inhibiting oils brings men one step nearer to victory in the struggle to keep the things they wrest from nature.

—But Don't Send Ashes

(Continued from page 134)

fect on the way that currency paper burns.

But these elusive clues are studied only when the serial number (the colored number of eight digits preceded and followed by a letter) or the face-plate number and check letter cannot be identified. The face-plate number is the very small black number above or a little to the right of the Secretary's signature. It indicates the number of the twelve-subject plate from which the note was printed; the check letter, which precedes it and is repeated in the upper left-hand corner, indicates the position of the individual subject on the plate, as follows:

A	G
B	H
C	I
D	J
E	K
F	L

As a result of this system, the number of possible check letters can by mathematics be reduced from 12 to two, for any given serial number, since the notes are consecutively numbered, beginning with 00000001. Divide the serial number by six. The remainder has two corresponding letters (numerically) between A and L. Notice that an odd remainder calls for an "odd" check letter, zero being considered even. Consequently, when a fragment is found bearing a check letter D, for example, it cannot be part of a note the serial number of which yields an even remainder when divided by six; conversely, if the remainder is four, then only check letters D and J can belong to the note in question.

While with pencil and pad I was verifying this, Mrs. Walker took an envelope from the desk drawer and produced an oblong paper on which fragments of char had been assembled into the shape of a nearly complete note. The burned paper was a solid, unembellished black.

"Speaking of the way paper burns differently," she said, "just look at this. This isn't real bank-note paper, at all. There was some pulp in it. It's a counterfeit \$20 Federal Reserve note."

Amazed at such uncanny deduction, I stood for a moment blinking, and then exclaimed, "You mean you can tell that those ashes are..."

"Don't call them ashes," she interrupted emphatically. "They're not ashes; they're char. We can't do anything at all with ashes. People who send us ashes just waste their own time and ours. When you write

your article, tell people *not to send ashes.*"

Impressed by her earnestness, I later set about learning the difference between ashes and the charred fragments unrecognizable as one-time paper.

Currency paper is made of linen and cotton; both are cellulose, containing carbon, hydrogen, and oxygen. When cellulose is heated, toasted, in a space containing insufficient air to permit complete combustion (isn't all burned up, that is), hydrogen and oxygen (H_2O) are driven off, leaving black carbon. When a bill is so treated, a wafer remains, coated with pigments of ink. That's char.

When currency paper is burned in a space with enough air to permit complete combustion, only a gray ash remains. It is composed of the noncombustible portions of ink and the mineral elements of the paper. This residue is worthless for purposes of reconstruction or identification. So don't send in ashes.

But at the moment, whether the reconstructed fragments were ashes or char seemed to be a matter of comparative unimportance. In either case, how could Mrs. Walker, without having made an analysis, tell that the remains were those of a counterfeit twenty-dollar note?

Her explanation, though no doubt lucid enough to one of her intelligence and experience, was completely beyond the writer's grasp. It was a consolation to realize, however, that the knowledge of how to distinguish between counterfeits and good notes in their original state is more useful to the average citizen—and certainly more easily acquired. You can develop that knack simply by "knowing your money." As Frank J. Witson, Chief of the United States Secret Service, trenchantly puts it, "The public's ignorance of its money is the counterfeiter's stock in trade." What it boils down to is a matter of comparison—the comparison of the suspected note with a genuine note. It is a story that can best be told graphically—in pictures, that is.

A large portion of the mutilated currency received for redemption comes in the form of char. After every large fire, shipments of burned notes can be expected. And with them nearly always comes a tragic tale. For example, there is the money from the *Morro Castle*. The scorched and battered strongbox that was taken from the sunken ship, after she burned near the New Jersey shore, reposes on a shelf above Mrs. Walker's desk. Again, there is the money received after disaster overtook a trans-

continental airliner. In June of last year, a thrifty housewife in Iowa stowed the family savings in a candy box and hid it in the chimney above the damper. On a chilly September morning her husband lit a fire. Three thousand dollars were burned beyond redemption—to ashes.

But while a great quantity of burned notes are redeemed, most of the money received for identification has been mutilated in other ways: money that has lain for months at the bottom of the sea; notes that have been chewed to bits; that have rotted into a compact mass; that have been hidden in pillowcases and under mattresses, and sent with the bedding, or in the pockets of shirts and overalls, to the laundry. It comes back so faded and blurred that you would think someone had replaced the genuine bills with counterfeits.

When you see the great number of securely capped iron pipes that have been used by money hoarders, you are apt to marvel that so many minds should think alike, or wonder if plumbers, especially, have an aversion to banks. But curious repositories for hidden wealth are legion. People hide their money in rusty cans, in fruit jars, in flashlights. They bury it in eyeglass cases and old shoes. They stuff it into automobile batteries, where it is eaten by the acid. They stick it in a bottle and hide the bottle in a swamp. In summer they stuff it in the furnace or let it rot in the damp coal bin. In winter they put it in the attic for mice to feast upon.

The titian-haired lady at the third desk of the second row is pasting on a piece of paper the amputated head of Andrew Jackson. Though numerous, most of the pieces are large.

"Termites," she said, smiling thoughtfully. "A man at South Bend, Indiana, hid \$6,000 in the rafters, where termites ate the bills. This is an easy case." (A "case" is any shipment received, no matter how large or small.) "I wonder why it's all in twenties. Odd that there should be no fives or tens—just twenties."

She had been working on the case only two afternoons, she explained, in turning from the desk, and had already identified \$4,600!

The work of identification is very hard on the nerves, as it requires intense concentration and more patience than Job ever dreamed of having. Therefore, the ladies of the Redemption Section labor at it only during the afternoons. In the mornings they do their clerical work for "relaxation." This it would seem, is almost as trying, because a great many little details must be painstakingly recorded. Cases may be reopened many years after their original disposition.

"If you're going to write a piece for a magazine," the titian-haired lady continued, "tell people not to use Scotch tape. It just makes it harder for us, and sometimes the evidence we're looking for is destroyed with the removal of the tape. It nearly always is with char. People shouldn't handle mutilated money, at all. They should send it along with everything in the container—except hard objects."

"Anything else?" I asked, making an entry in my notebook.

"Yes, here's another 'don't': don't send in the residue of an incinerator—bottle tops and garbage. People sometimes do. It's awful." She glanced at her wrist watch and returned to her work.

From a pile of debris her tweezers selected a small fragment with serrated edges. It was Andrew Jackson's scalp.

Money that is thoroughly rotted is definitely an unpleasant sight. Certainly the miserable remains of \$230 that had been taken from a buried shoe (time: April 14, 1944; place: Chicago) were a mess. The upper part of the shoe had completely disintegrated. Enough remained of the lower portion and the sole to reveal a cobbler's nightmare. The money itself defied description—that is, the portion of it now housed in a pasteboard box on the desk: rolls of organic matter that had been converted into some substance of stony hardness.

Yet the stony hardness yielded to the expert fingers. Fragments and strips of delicate tissue peeled off the compact bundles. If you can imagine one side of the Grand Canyon reduced to the size of a Brazil nut, and the paleozoic strata stripped off by a highly manicured fingernail, you will have an approximate picture of this sorceress's performance.

The fabulous amount of currency sent in for redemption does not all come from individuals or corporations. The millions—billions, in fact, as time passes—come through Federal reserve banks and fiscal agents. For the most part, these are worn-out notes, unfit for further circulation. They are classified, tabulated, counted, recorded, and finally destroyed in the incinerator—an inferno hot beyond the conception of Dante—and reduced to ashes.

Ashes, indeed.

But all that is no concern of the Redemption ladies, who are the fairy godmothers of the shiftless, or careless, or overcautious, or simply unfortunate people whose money has become mutilated. They are our unknown friends, these ladies of the Treasury of the United States, Currency Redemption Division, Washington, D. C.

So *don't* send them ashes.

ANTI-FREEZE USERS

"PRESTONE" Anti-Freeze

is being distributed under W.P.B. Plan

THE ARMY, NAVY, AND LEND-LEASE are taking millions of gallons of "Prestone" anti-freeze. This leaves a reduced supply for civilian consumption.

The War Production Board, assisted by the Anti-Freeze Industry Advisory Committee, has worked out a plan of distribution of the available supply of all types of anti-freeze based upon a state allocation system. Under this plan there is every reason to expect that there should be enough anti-freeze to keep the nation's motor vehicles running this winter.

However, the chances are that "Prestone" brand anti-freeze will be rather scarce in many localities. Yours may be one of them. So, see your dealer early. Have that feeling of security that comes when you have the world's finest anti-freeze in the radiator of your car. One shot lasts all winter. It doesn't boil away, evaporate or lose effectiveness through "foaming." Protects against rust and corrosion.

NATIONAL CARBON COMPANY, INC.
Unit of Union Carbide and Carbon Corporation



The words "Eveready" and "Prestone" are registered trade-marks of National Carbon Company, Inc.

*Keep your eye on the Infantry
— THE DOUGHBOY DOES IT!*

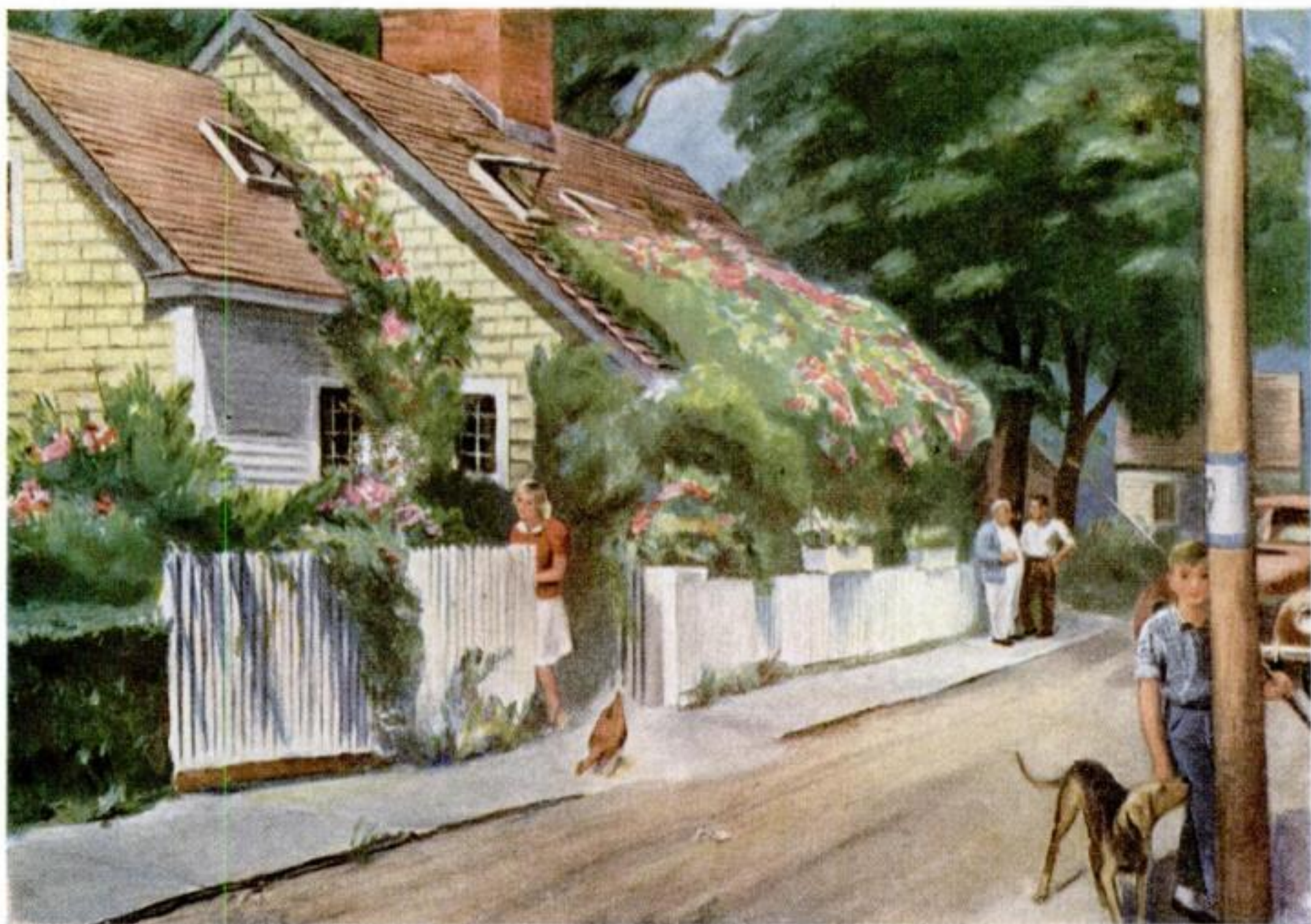
O. P. A. RETAIL
CEILING PRICE
\$2.65
PER
GALLON



...YOU'RE SAFE, AND YOU KNOW IT WITH

PRESTONE *Anti-Freeze*

TRADE-MARK



"Talking It Over" painted by Rudolf Wetterau

Home

Home is a lot of little things—the way you want 'em. A certain chair, and the ticking of a clock, the smell of what's on the stove, your old hat, and good friends.

And among these is a pipeful of tobacco, and plenty of time to enjoy it.

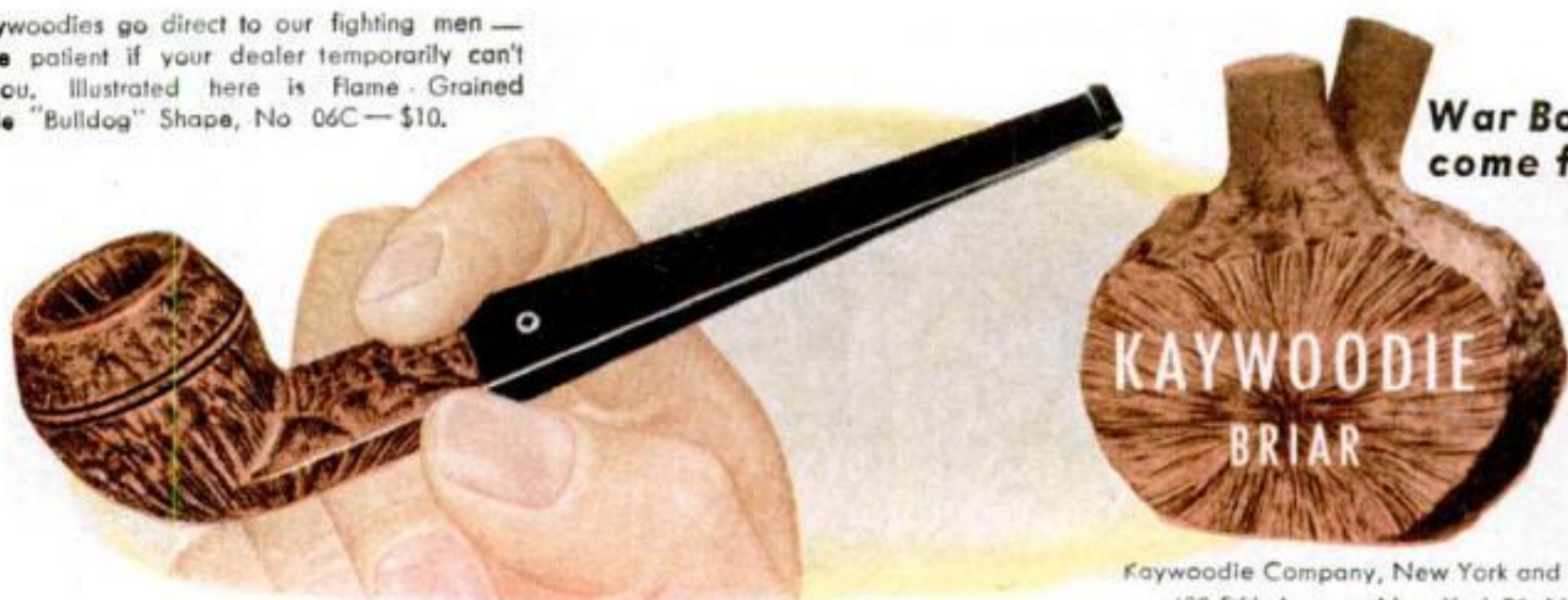
Kaywoodie Pipes are part of this picture. When the work is done, when the slugging is over, when you've sweat it out successfully, you'll have the finest pipe that money and experience and painstaking care can produce. Kaywoodie promises you that.

A Kaywoodie takes years to make, and is, we believe, the mild-

est, coolest, pleasantest form of smoking. This is due to the Kaywoodie Briar which comes from the countries surrounding the Mediterranean Sea (and only from there). You can't rush it, or mass-produce it, or short-cut it. After it has grown, it has to be seasoned and mellowed, aged and tempered, so it will draw the goodness from tobacco, and yield a cool, smooth, delicious smoke...a smoke free from trouble, with the distinctive "Kaywoodie Flavor."

Yes, Kaywoodie is, and will be, one of the things worth while in your home.

Many Kaywoodies go direct to our fighting men — please be patient if your dealer temporarily can't supply you. Illustrated here is Flame-Grained Kaywoodie "Bulldog" Shape, No. 06C—\$10.



**War Bonds
come first**

Tricks of Fake Mediums

(Continued from page 71)

silence, as if she were struggling for the words. "He wants to tell you to stay here. Do not go back home. He said, 'Don't worry about me. I am happy.'" Another pause. "You have pains," she moaned. "Pains here," and she pressed the hand with the envelope in it to her head. "Go see an oculist."

How she was able to read my questions through the envelope is explained in the drawings on page 68.

From this "church" we taxied over to see the medium whom I shall refer to as Dr. S. Here, with minor differences, we found the same kind of setup as at Laura's place. This time, however, instead of sealing our questions in an envelope, we were told to fold the slips of paper on which they were written. Dr. S. went through a hocus-pocus of holding each folded slip to his forehead while the "spirits" came through with the answers to the questions.

Miss Mackenberg nudged me. "The old billet-switch trick," she whispered. "Houdini often exposed it."

The billet trick, Miss Mackenberg later explained to me, has numerous variations, but the elementary principle is the substitution by sleight-of-hand of a folded paper identical in appearance to the one on which the victim has written his question. How it is done is shown in the diagrammed drawings on page 71.

Since so many persons preceded us, our questions were not answered until very late. The meeting had opened at 7:45 p.m. The crowd must have changed at least twice before we got there. This would make the "take" for the evening over \$125.

Except for the fact that he brought a little old lady into my "seance," the answers were much like those I'd heard before. After quoting from the Scriptures, he shut his eyes and said: "I see, I see, I see—a little old lady, one who has passed away many years before, at your side. She says, 'God bless you.' Yes, she knows Charlie. Neither one of them thinks you should return home. They are happy. They want you to be happy. Don't worry about those pains in your head."

Later, Mr. Proskauer told me that he had known these mediums and seen them operate over a number of years. "They are super confidence men and women," he said, "who trade with diabolic showmanship on the sorrow of others. The same pattern is being repeated in every city in the United States. During and following every war, thousands of these mediums spring up. It

happens to be worse this time because the present war has been a long one and there have been many casualties.

"The one phrase, 'Consolation for the bereaved,' which these mediums use is the snare that is trapping thousands of relatives, wives, sweethearts, and parents of dead soldiers and sailors. Revealing the tricks these shysters use may save others. Professional magicians are particularly incensed because, to defraud others, the mediums are using the tricks which the magicians have spent years developing for entertainment."

The other tricks most frequently used to dupe the customers, Mr. Proskauer explained, are slate writing, table tilting, trumpet messages, spirit manifestations, and table rapping.

Slate writing is most convincing and uncanny, even to a magician or one versed in mediums' wiles, unless he is familiar with chemistry and physics. In one method the victim is handed two slates and a piece of chalk. He is then told to place the chalk between the two slates and tie or tape them together.

"The secret lies in the chalk," says Mr. Proskauer. "Seemingly nothing but an ordinary piece of chalk, which anyone may buy at a store, it really is pulverized chalk mixed with a little water, glue, and iron filings, molded and allowed to become hard.

"The medium, after the slates have been sealed with the chalk between them, places them under his table. When they are out of sight, he brings out unseen a small but powerful magnet and traces with it the words he wants to appear. As he writes, the magnet pulls the chalk along noiselessly. The iron filings in the chalk nastrally follow the magnet, and while the writing is always somewhat shaky and spiritlike, it is always readable.

"Another method is to switch the slates with a confederate concealed behind curtains. The confederate does the writing and returns to the medium an identical pair of slates."

Table rapping usually is produced with an accomplice sitting at the table with the medium. Hands are joined, but in the darkness the medium releases one hand from that of her accomplice. She uses a hollow heel and hammer arrangement with a string running up to her garter. With her free hand, she simply pulls the string and produces the raps on the floor. It is almost impossible, in a darkened room, to tell from which direction the sound comes, particularly when the victim is keyed up.



Filing nicks out of propeller blade of Budd-built RB-1 transport plane.

EVERY detail in the maintenance of a costly giant of the air is important. Taking nicks out of a plane's propeller blade *could* be done—after a fashion—with a randomly selected file; but modern shop practice says, "No! Use the right file for the job." With Nicholson Files, that admonition can be obeyed. For smooth-filing aluminum and aluminum alloys (like airplane propellers), the specially designed Nicholson "Aluminum Type A" usually does the job best.

Hundreds of other filing jobs present similar situations. "Know your files and get ahead" is today's advice to the forward-looking mechanic. Know Nicholson Files and your knowledge of file types will be up to the minute.

FREE BOOK, "FILE PHILOSOPHY." It can give you more information about file kinds, use and care in half an hour's reading than months of "apprenticing." . . . 48 interesting illustrated pages.

NICHOLSON FILE CO., 19 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON

FILES

FOR EVERY
PURPOSE

The trumpet performance is a little more complicated. One method, repeatedly exposed by magicians, requires a small "gimmick." The trumpet itself is a metal cone about four feet long, painted black. On the mouthpiece end, the one the "spirits" use when they talk, is a wooden tip, turned to fit tightly over the metal.

Concealed about the medium's person is a round base of wood, which fits snugly into the wooden mouthpiece, like a cork in a bottle. When the lights are put out, she reads the questions, which have been laid face downward on the table in front of each visitor at the table, by using a "reaching rod." This is a contraption of collapsible tubing which, when opened, may be 10 feet in length. On the end of the rod is a pair of tweezers worked by wires running down the shaft of the rod. The medium picks the question up with this rod. The paper is slipped into the wooden tip on the base of the trumpet. This tip contains a small battery and a flashlight. The medium bends over the trumpet and reads the question inside. The light cannot be seen outside the trumpet. The trumpet tip is then removed. The medium places the now innocent trumpet to her lips and the other end near the victim, and in a disguised, ghostly voice answers the question.

There are scores of tricks, depending on the ability of the medium. Spirit photography is a stunt in which the victim is photographed with the image of a loved one faintly outlined in the background. This is achieved by especially treated photographic plates or trick photography. Spirit manifestations in which the medium appears to exhude "ectoplasm," a wraithlike vapor, require expert manipulation. One famous medium, who was exposed, was found to be able to swallow yards of specially prepared cheesecloth and in the darkness to bring it forth from her mouth, creating the illusion that a spirit substance was emanating from her.

The multimillion-dollar racket thrives despite efforts of authorities to suppress it. Nearly everyone is a little superstitious. Will you light three cigarettes with one match? Are you careful what you do on Friday? The spook crook's golden opportunity lies in this human trait. One great asset they have, Mr. Proskauer explains, is showmanship.

"You go to see them," he says, "because you think there might be something in it. Step by step they build you up to an emotional climax where your reason loses control. Then they tell you the spirits can say no more today. You can come tomorrow and tomorrow—until your money is exhausted."

The lamp that *DOES NOT GROW DIM!*



STURDY, ONE-PIECE,
"ALL-GLASS" UNIT...NO DIRT
OR MOISTURE CAN SEEP IN

2 FIXED-FOCUS
FILAMENTS
ACCURATELY LOCATED

MIRROR-LIKE
REFLECTING SURFACE OF
VAPORIZED ALUMINUM

LOOK FOR G-E HERE

THE WHOLE THING IS A BULB

BUY WAR BONDS
AND HOLD THEM

SEE WHY

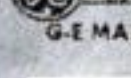
it means safer night driving for you



LIGHT OUTPUT



G-E MAZDA SEALED BEAM WHEN NEW 100%



G-E MAZDA SEALED BEAM AT END OF LIFE 99%

Here's a picture of the performance of an average G-E Mazda Sealed Beam lamp, based on years of road and laboratory tests. Up to the very end of life, it gives you 99% of original light!

SAFETY from start to finish! That's what General Electric Lamp Research has given you in the amazing G-E "All-Glass" Sealed Beam lamp...*the lamp that does not grow dim!* The whole thing is a rugged, hermetically sealed bulb which air, dust and dirt cannot penetrate. The reflector *never* tarnishes.

Play safe! When a headlamp burns out, replace it with a G-E "All-Glass" Sealed Beam lamp. You can use G-E Sealed Beam lamps in *any* car that has a "sealed beam" headlighting system. *And for most pre-1940 cars* sealed beam adaptors are available. Ask your service station, garage or dealer for G-E Sealed Beam lamps...*the lamps that do not grow dim!*

SAFETY FROM START TO FINISH!

G-E MAZDA SEALED BEAM LAMPS

GENERAL  ELECTRIC

Hear the General Electric radio programs: "The G-E All-Girl Orchestra", Sunday 10 p. m., EWT, NBC; , , , "The World Today" news every weekday 6:45 p. m. EWT, CBS.

NOVEMBER, 1944

Buy War Savings Bonds and Stamps regularly.

215

Hydraulic "nerves" and "muscles" for superhuman tasks

How is a huge, 16-inch gun turret on a battlewagon swung into firing position? . . .

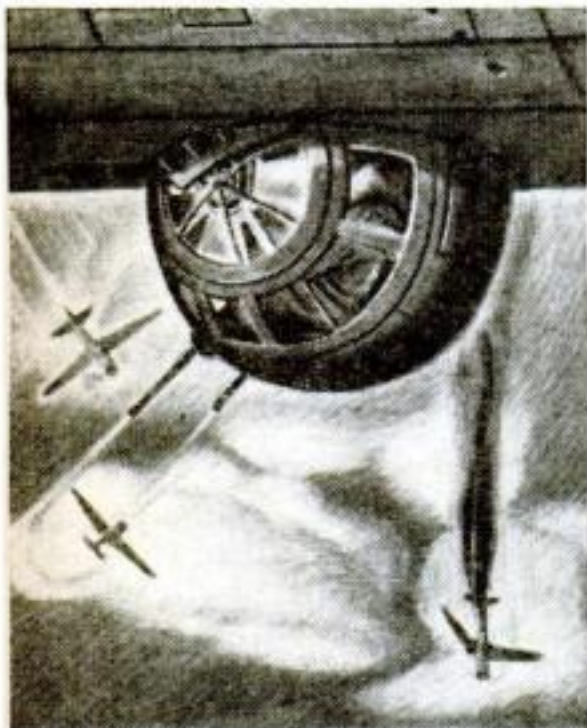
How is a big 90-mm. antiaircraft gun kept trained on its fast-moving target?

These and other tasks of warfare are too tough for the controlled muscle power of mere man. So they are performed by made-to-order "nerves" and "muscles" of steel and oil, using the principle of *hydraulics*.

Hydraulic "nerves" and "muscles" can move and control many hundreds of tons at the touch of a finger on a lever. *And with hairbreadth precision.*

Even before the war, Vickers Inc., a division of the Sperry Corporation, had years of experience in applying hydraulic power and control to industrial devices, and to Army and Navy weapons

Wartime brought additional assignments. Here are a few examples . . .



They turn the belly turret of a Liberator—against terrific wind pressure. That takes plenty of muscle—so the "muscles" and controls are hydraulic—for speed, precision, smoothness.



They spin the 1550-ton turret on a battleship. This means training and elevating the monster 16-inch guns mounted three abreast in a heavy, armored turret. Precision, speed, and dependability are vital. The hydraulic drive is one reason for our Navy's deadly gunfire.



They keep ack-ack guns on the target. In response to firing data from the Sperry Antiaircraft Director, our Army's 90-mm. antiaircraft guns are automatically positioned on the target. The hydraulic control mechanism responds to a movement of a *thousandth of an inch* of the controls.



They open the mouth of an LSM. When it's time for the bow doors of a *Landing Ship Medium* to open, it's time for action. Positive, dependable operation may be a matter of life or death. This heavy job is entrusted to Vickers hydraulics.



While the applications of hydraulics to modern weapons are spectacular, Vickers equipment is performing equally important tasks on the production front.

Giant presses, intricate machines for making munitions, machine tools, and oil-well machinery are but a few examples.

When Victory permits, Vickers precision hydraulic equipment will help produce hundreds of postwar products.

SPERRY

C O R P O R A T I O N
30 Rockefeller Plaza, New York 20

FORD INSTRUMENT CO., INC.
SPERRY GYROSCOPE CO., INC.
VICKERS INC.
Waterbury Tool Division, VICKERS INC.



**GET YOUR
HORSEPOWER**

*Ready
for Winter*



Casite Guarantees Summer Starting in Winter Weather or Double Your Money Back.

● Old Man Winter is roaring 'round the corner again. And back with him come winter starting worries. Your engine coughs and sputters . . . refuses to start . . . runs down the battery . . . causes needless delay and expense.

Casite is the guaranteed answer to

winter starting troubles. Casite cleans out motors and keeps them clean—speeds oil flow, gives quicker compression. Result: your engine leaps to life, even in the coldest weather.

Casite is sold by service stations, car dealers and garages everywhere, for only 65¢ a pint.

THE CASITE CORPORATION • HASTINGS, MICH.

Guarantee

We guarantee that any motor capable of being started in a warm room will start in the coldest weather when Casite is added to the crankcase . . . Add Casite according to instructions. If your car fails to start, you get double your money back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is \$1.30 per pint, which is twice the nationally advertised price of Casite.



CASITE

**CLEANS OUT MOTORS
KEEPS MOTORS CLEAN**

★ BUY MORE WAR BONDS ★

WORKSHOP WISDOM

How to make linoleum stay down



IT'S EASY to make an excellent linoleum cement with Casco Glue. Simply mix 1½ measures of Casco with 1 measure of water.

Apply this mixture liberally to the clean floor with a heavy brush. Roll linoleum carefully over this space and place sandbags or weights on top surface to assure even pressure. Keep weights on for 12 hours or overnight.

Casco Glue wins on 4 counts

Unusual strength. Casco Glue hardens and sets chemically to form a bond of remarkable strength and toughness.

Greater durability. This glue is highly resistant to dampness, heat, and age.

Easy to mix. Casco Glue mixes easily with cold water—no heating problems.

Economical. A little Casco goes a long way. Mix it as you need it. The powder, if tightly covered, lasts indefinitely.

For special outdoor jobs and water projects, ask for Cascamite—the waterproof plastic adhesive.

You can get both Casco Glue and Cascamite in 10¢, 25¢, and larger sizes at all hardware stores.



Send for free Casco Project Booklets and free Gluing Guide containing 80 household gluing hints. Just address a post card to Casein Company of America, Dept. S2, 350 Madison Avenue, New York 17, N. Y.

CASCO Powdered Casein GLUE

"Sets chemically—hardens permanently"

Miracles in Bonding

(Continued from page 78)

general public in small packages shortly.

Phenolic, melamine, and urea resins are classed as thermo-setting materials. The term has a very special meaning in the adhesive and plastics industries. These resins, when heated, first melt and then solidify while still hot. They cannot be liquefied again by heat. There is another class of synthetic adhesives called thermoplastics, which act differently and are therefore employed for different purposes. These are applied by heating and set only when cooled. The same amount of heat will liquefy them again. These are used in a great many applications such as the bonding of fabric to produce waterproof raincoats, ponchos, and tarpaulins. They have the advantage of remaining flexible after setting and also the important property of high resistance to gasoline, oil, and other substances that rubber cannot withstand.

As might be expected from all this, the new adhesives have also entered the packaging field with sensational results. Wartime needs for waterproof packaging of food and many other supplies have brought suddenly into being some entirely new and higher standards. The armed forces have naturally demanded packages that would stand the utmost in weather, and they have got them from the packaging industry by the rapid development of resin-based adhesives of many different formulations. They even got packages that could be thrown overboard and floated ashore without coming apart, and that are oilproof, verminproof, gasproof, and moldproof.

Will older forms of glue go out of use as a result of this rapid development of new and better adhesives? Nobody predicts that as yet. In general, the synthetic resins are costlier than ordinary glues. In wartime we pay little attention to costs, but the stiff competition of civilian business is a different matter. The great strength and durability of the new glues insure their use to the exclusion of others in many applications. In other cases the older starch, casein, and animal glues will be good enough. It is difficult to make accurate predictions at this stage, but at any rate we now have glues for all purposes which are so far superior to those we have known heretofore that we need to revise our ideas entirely as to what an adhesive really is and what it can do.

The director of one of the big research laboratories puts it this way: "Before the war, glue was merely stickum; now it is an engineering product."

Here's how your car FEELS...

... after
MARFAK
chassis
lubrication!

Now's the time for MARFAK chassis lubrication. Keeps your car *limber* despite freezing weather, makes winter driving smooth and effortless. MARFAK is extra tough and long-lasting. And your Texaco Dealer applies it by chart . . . never by chance! Every point of wear, every point of adjustment gets a going over . . . from tie rods to spring shackles. But don't wait. Colder weather's just around the corner. Ask your Texaco Dealer to give your car that "MARFAK feeling" today!

THE TEXAS COMPANY



TUNE IN the TEXACO STAR THEATRE starring James Melton every Sunday night. See your local newspaper for time and station.

NOVEMBER, 1944

Buy War Savings Bonds and Stamps regularly.

219

SCREWBALL IDEAS ON BATTERY CARE



Gideon P. Shorthaul is puzzled. Several nights each week, he has been driving his car around the block to keep his battery charged. But it didn't work. Actually, his starter and lights used more juice than his generator could replace on these short hops. You were only wasting precious gasoline, Gideon!

...THE WISE WAY IS PERIODIC RECHARGES!

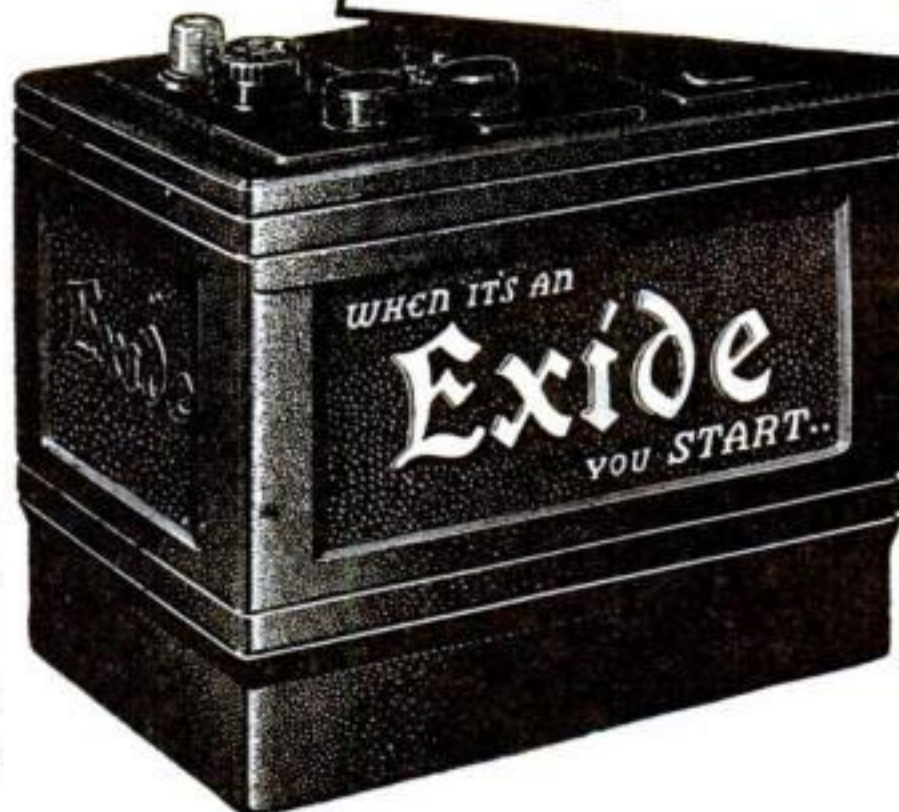
GAS rationing means restricted driving . . . and that's bad for your battery. But don't let your battery go "dead." Drive in to your Exide Dealer occasionally for a **FREE CHECK UP!** When necessary, he'll advise a recharge which will keep your battery strong. **PERIODIC RECHARGES** cost little, but they postpone the day when you'll need a new battery. When you *must* buy, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

**EXIDES ARE USED IN MORE THAN 100
APPLICATIONS BY OUR ARMED FORCES**



- 1 Don't buy *anything* you can do without.
 - 2 If you **MUST** buy, insist on dependable, long-lasting merchandise.
 - 3 Take care of the things you have. *Make them last!*
- These conservation rules save materials for war production, help curb inflation, give you more money to invest in War Bonds.



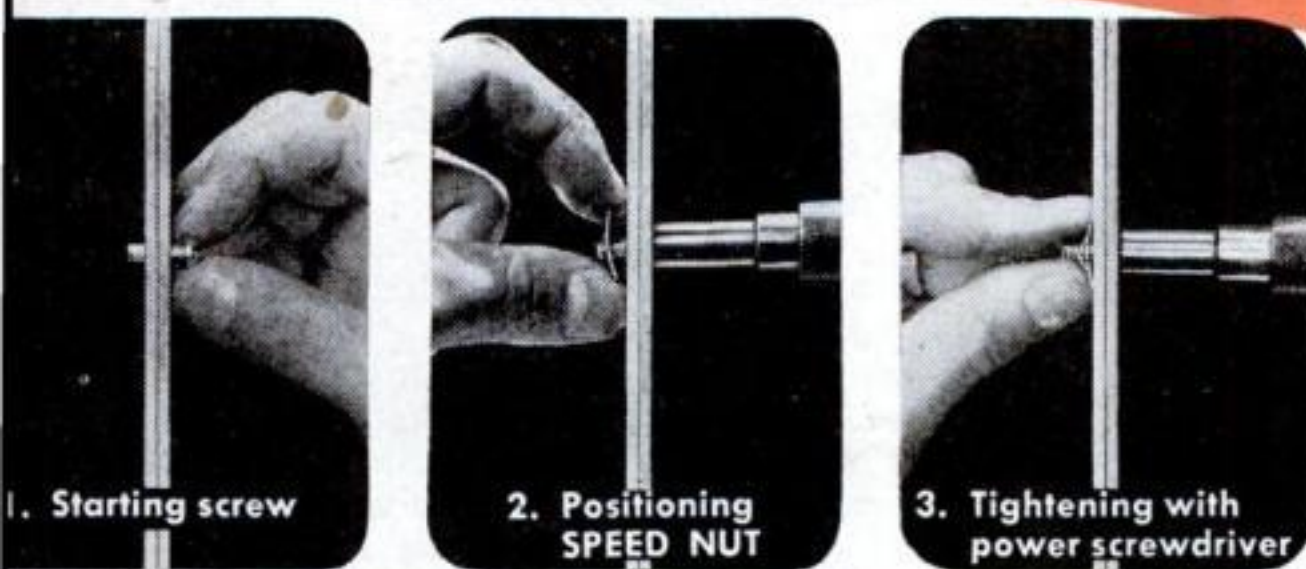
Which is Better?



THE OLD WAY WITH

5

HAND OPERATIONS

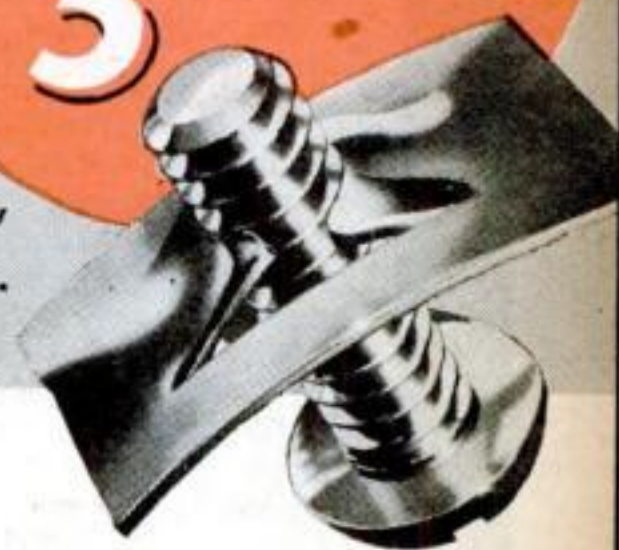


OR THE
SPEED NUT

WAY WITH ONLY

3 OPERATIONS

And a SPEED NUT is a self-locking nut, too, that weighs less, stops vibration loosening and cuts assembly costs 40-50% . . .



The SPEED NUT method requires only 3 hand operations as shown in photos above. And only 2 parts are needed instead of 3. Why go through 5 hand operations when only 3 are necessary? Why handle 3 parts when only 2 are required? For an eye opener on the economies of the SPEED NUT system just multiply this 40% motion-saving by the millions of fasteners you use per month. Then add to that the saving by eliminating 1/3 of the parts. Your figures will amaze you. The winning products in postwar competition will be those

that are assembled faster and protected against loosening from vibration. Billions of SPEED NUTS were used before the war and on war products, too. More billions will be used on postwar products. Over 2,000 shapes and sizes. Engineers who move up faster are those who know how to make assembly lines move faster. Write for literature.

TINNERMAN PRODUCTS, INC.

2022 FULTON ROAD, CLEVELAND 13, OHIO

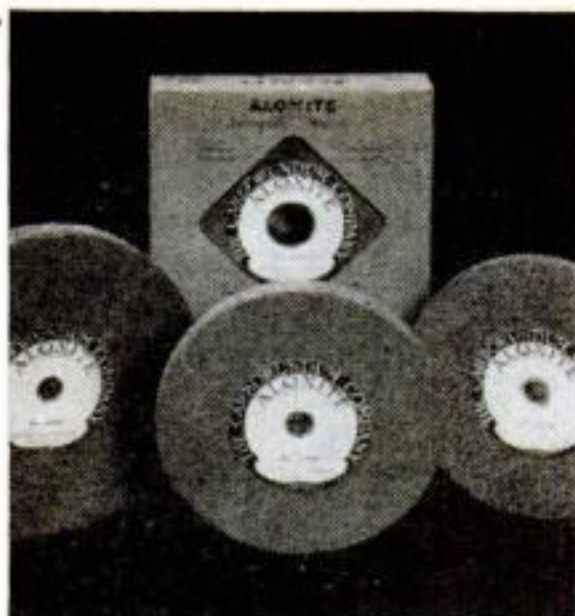
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario

In England: Simmonds Aerocessories, Ltd., London

F A S T E S T T H I N G S I N F A S T E N I N G S

Speed Nuts ★
[PATENTED]

*Trademark Reg. U. S. Patent Office



How to use Grinding Wheels

THE secret of using a grinding wheel successfully is to select one that is of the right grit and grade for the work to be done, and then to operate it at the proper speed. Although, where maximum efficiency is required, such as in production work, it may be desirable to use a wheel designed for the particular job, it is not necessary to have a large assortment of wheels for all-purpose grinding such as that encountered in the average home workshop, garage, repair shop and on the farm.

Wheels made from Carborundum Brand Silicon Carbide are adapted particularly to the grinding of brass, aluminum, cast iron, bronze and other metals of low tensile strength. Wheels made of Aloxite Brand Aluminum Oxide are used for grinding all kinds of tools, steels, metals and materials of high tensile strength. Sold by hardware dealers everywhere.

To get full information on the use of grinding wheels in your workshop, write for your free copy of "Short Cuts to Better Work for the Home Craftsman." The Carborundum Company, Niagara Falls, N. Y.



Dept. S-114

THE CARBORUNDUM COMPANY

TRADE MARK

Niagara Falls, N. Y.

(Carborundum and Aloxite are registered trade marks of and indicate manufacture by The Carborundum Company)

New Era in Bombing

(Continued from page 98)

of that number. An enemy fighter trying to get at the pilot and copilot flies directly into the fire of eight guns. All of these guns are remote-controlled. All of them compensate automatically for range, deflection due to the speed of the firing platform, the speed and course of the target, the effect of gravity, and other variables.

At the start, some of the experienced gunners didn't like the remote-control device. They could do better with an ordinary power turret, calculating their "lead" in their heads, they said. So to show them, we held a contest. We put green gunners at the remote controls and pitted them against the old-timers. For the men at the remote-control guns it was like shooting fish in a barrel. That settled the argument.

The record of enemy aircraft shot down on raids is eloquent of the plane's firepower. In two raids in which the fighter opposition was described as weak to rather light, the gunners accounted for a total of 21 planes plus 22 probables and 23 damaged.

B-29 crews were somewhat baffled when the Japs broadcast that the "super air fortresses, being larger than ordinary bombers, were easier targets for our fighters." It didn't make sense. Nor did it make sense when Tokyo in the next breath announced that key cities in the Japanese homeland would be evacuated in part.

The plane's speed is protection in itself.

In one flight over the Hump from China to India, a B-29 was jumped by a half dozen Tojos near Myitkina, Burma, at an altitude of 22,000 feet. The Tojo is a fast, radial-engine fighter that looks somewhat like a P-47. This particular Superfortress had never been on a combat mission. Its crew was green. The Japs stacked up high to take their turns.

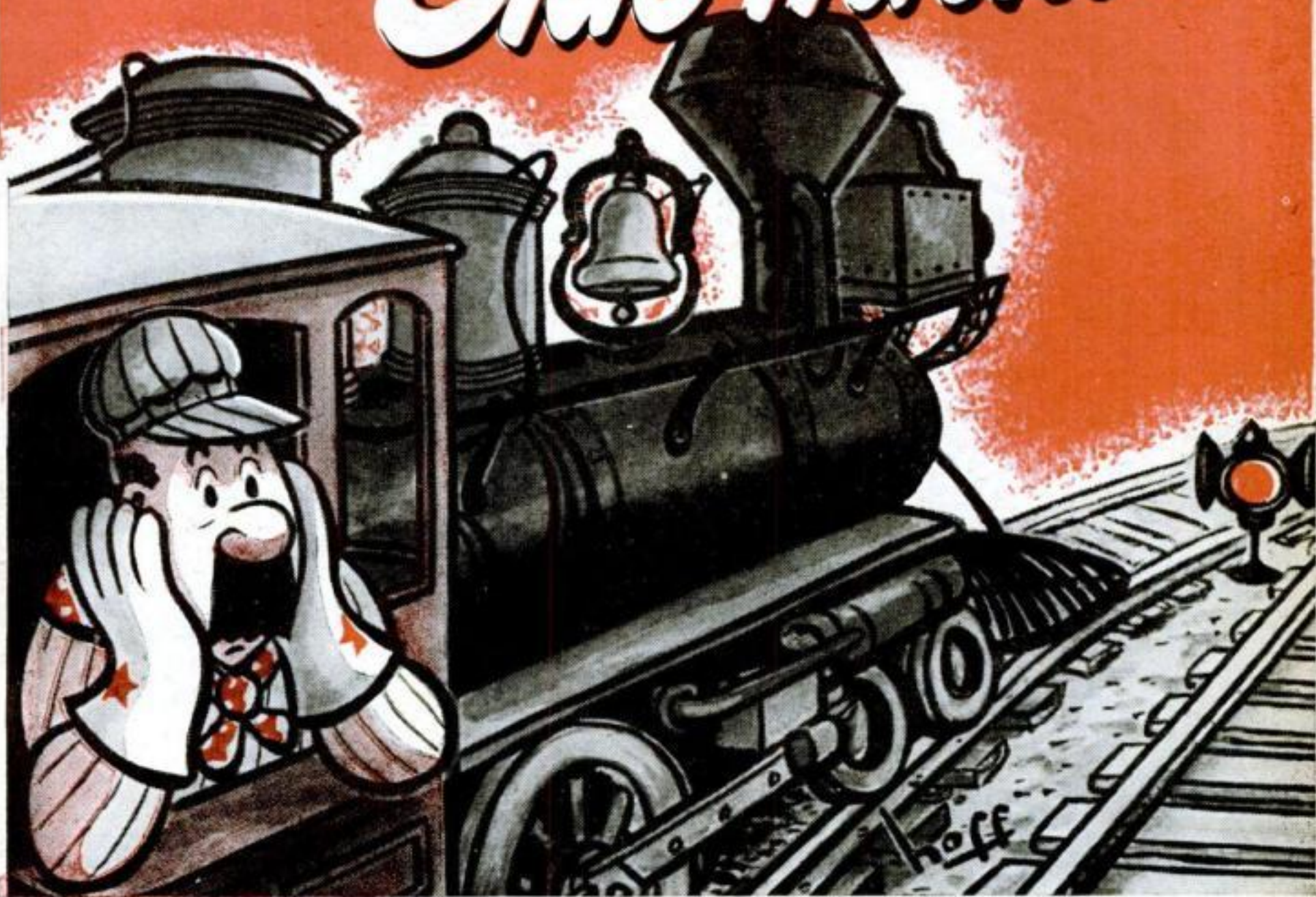
The first one to make a pass did get in some shots, but in trying to establish a normal assault curve that would bring him out in a safe dive he misjudged his target's speed. He had to cock his plane over almost on its back to bring his guns to bear, and as he peeled off his belly offered a perfect target to the bomber's rear gunner. The Jap went down smoking.

The other five Tojos dived, but all they hit was thin air where the B-29 had been.

The altitude at which the B-29's fly is additional protection. Our crews have seen the best of the Jap fighters struggling to get abreast of them after half of a Superfortress task force had bombed the target

(Continued on page 226)

DON'T BE *Side tracked*



Switch to Auto-Lite Batteries

Be guided by the experts who choose batteries for the world's toughest transportation services. For example, the million-mile trans-ocean flying record was established by a Pan-American Clipper equipped with Auto-Lite batteries.

Auto-Lites, too, are specified for service with our

fighting forces in tanks, half-tracks, jeeps . . . wherever dependable power counts.

Get the long life . . . the extra power you need. Buy an Auto-Lite battery—specified as original equipment by leading automotive engineers.


Auto-Lite
means
Auto-Life



AUTO-LITE BATTERY CORPORATION • TOLEDO, 1, OHIO

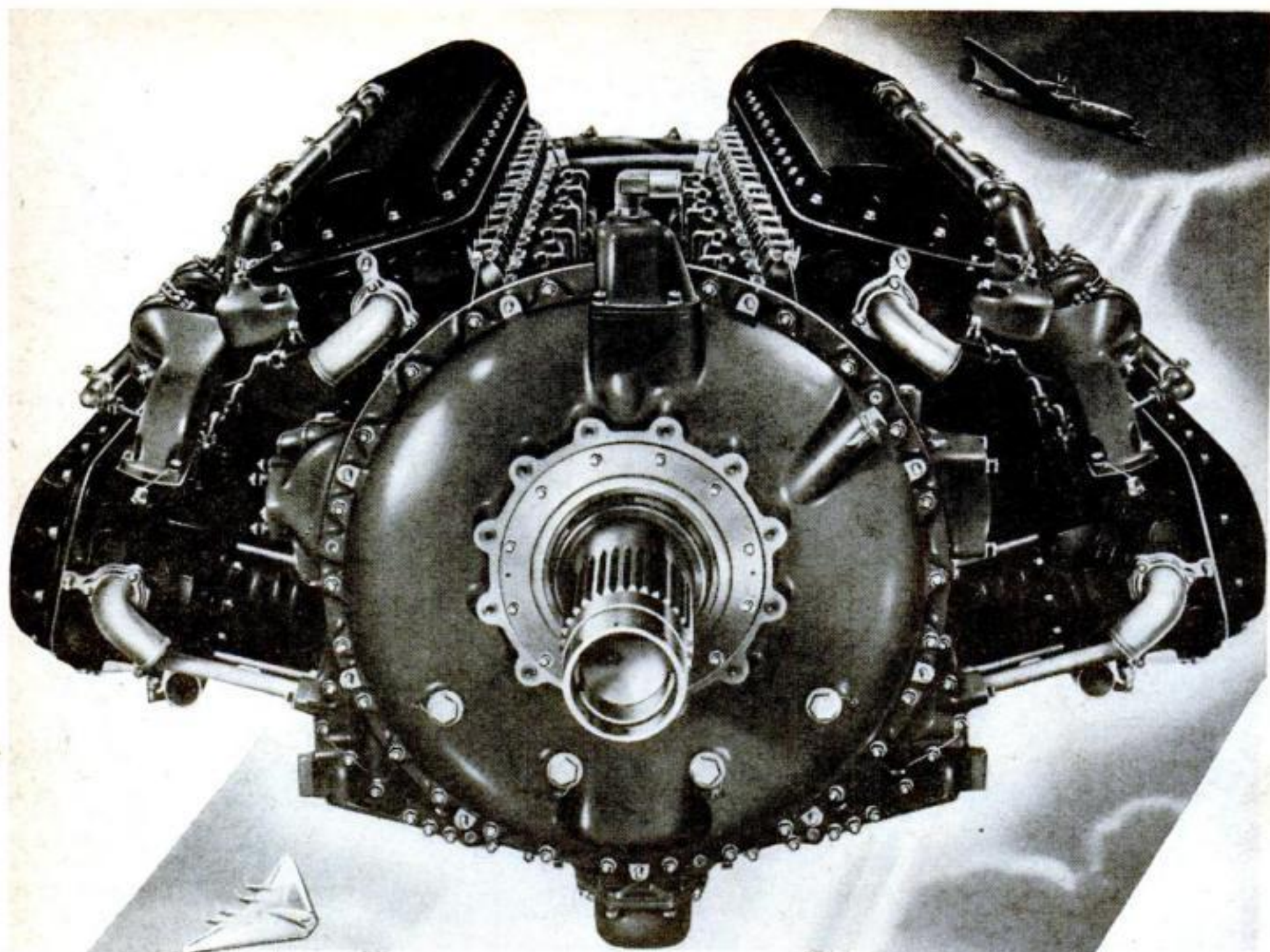
Manufacturing Plants at:

Niagara Falls • Atlanta • Indianapolis • Oakland • Oklahoma City • Toronto



Tune in
AUTO-LITE'S
GREAT RADIO SHOW
STARRING
DICK HAYMES
IN
"Everything for the Boys"
Every Tuesday Night . . . NBC Network
Featuring stars of stage, screen and
radio and men and women at
the fighting fronts

AUTO-LITE BATTERIES



A LIQUID-COOLED GIANT — THE WORLD'S MOST POWERFUL

Going into America's new planes is the most powerful liquid-cooled aircraft engine in the world. ★ It is an Allison engine — of approximately 3,000 horsepower. It is more powerful by hundreds of horsepower — gives our pilots over a third more power to work with than the huskiest engine they had before. ★ Virtually all its parts are the same as in other Allison engines. So plane crews around the world can service it right now. ★ Its high power, long range, smoothness and dependability are qualities vital in the days of war, and equally important in the planes in which you will fly when peace returns.

**KEEP AMERICA STRONG
BUY MORE WAR BONDS**

POWERED BY ALLISON

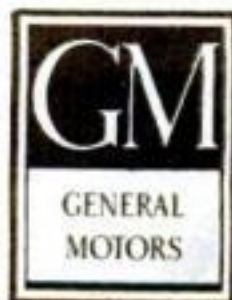
P-38—Lightning
P-39—Airacobra
P-40—Warhawk
A-36 and P-51—Mustang
P-63—Kingcobra

The more-than-50,000 Allison engines built for the U. S. Army Air Forces power the above planes.

LIQUID-COOLED AIRCRAFT ENGINES

Allison

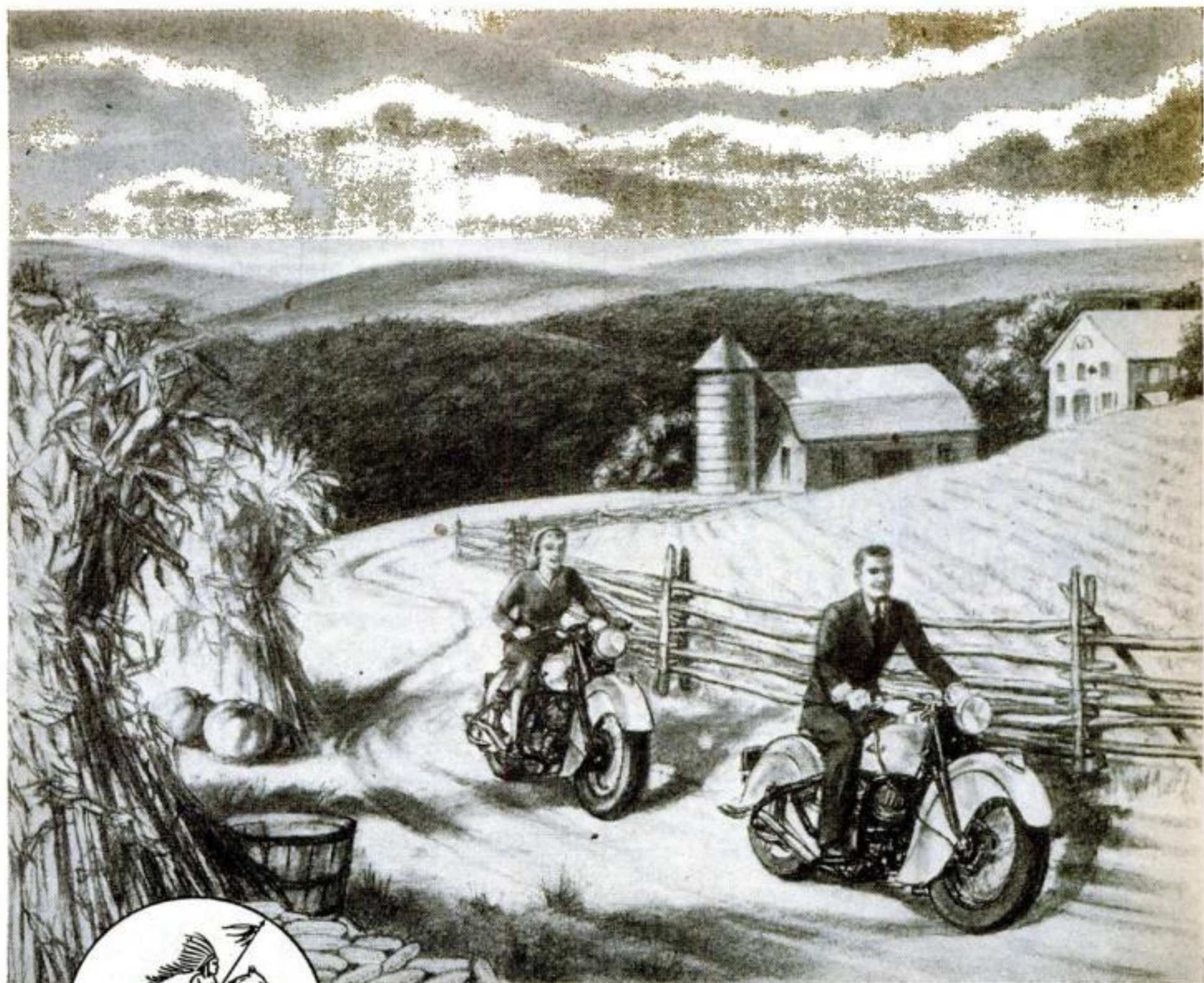
DIVISION OF



Indianapolis, Indiana

Every Sunday Afternoon

GENERAL MOTORS SYMPHONY OF THE AIR — NBC Network



Head for the Open Road

JUST a moment from America's Main Street await the thrills of the open road . . . thrills we have put aside as we strive for the Victory days ahead.

For the open road holds an allure known to motorcyclists everywhere. Riding along . . . up and down hill . . . the cool breezes always in your face . . . and a feeling of elation, of sure control over the power waiting only the twist of your wrist to leap into action. If you've never known the real thrill of the open road . . . of riding an Indian motorcycle . . . you'll want to in the days ahead when the motorcycle sport gets back into full swing.

Indian, with its exclusive Spring Frame comfort, bril-

liantly powerful engines and streamlined design offers motorcycling at its very best. To head for the open road now on an Indian . . . or in postwar days on one of the Indians designed to make motorcycling an even greater and more economical travel pleasure than ever before . . . is a pleasure you can make your own.

Find out about motorcycling and about Indian, now! Put your coupon in the mail . . . Today.



*Read
about
Motorcycling*

**BUY WAR BONDS NOW
TO BUY AN INDIAN LATER**

Indian Motorcycle Company
Dept. PS-11 Springfield, Mass.

Please send me *Indian News* . . . and put my name down to receive any new Indian announcements.

Name.....

Address.....

City..... State.....

Indian

MOTORCYCLES

NOVEMBER, 1944

Buy War Savings Bonds and Stamps regularly.

225



WHAT KIND OF A "LIGHT" DO YOU WANT IN YOUR HOME AFTER THE WAR? SEE THIS NEW LIGHT AT YOUR DEALER'S

● VERD-A-RAY is a new type of incandescent light bulb scientifically designed to make seeing easier. In comparison with the "pinkish" white light of ordinary frosted lamps, note the comforting "pastel greenish" white light emitted by VERD-A-RAY.



VERD-A-RAY

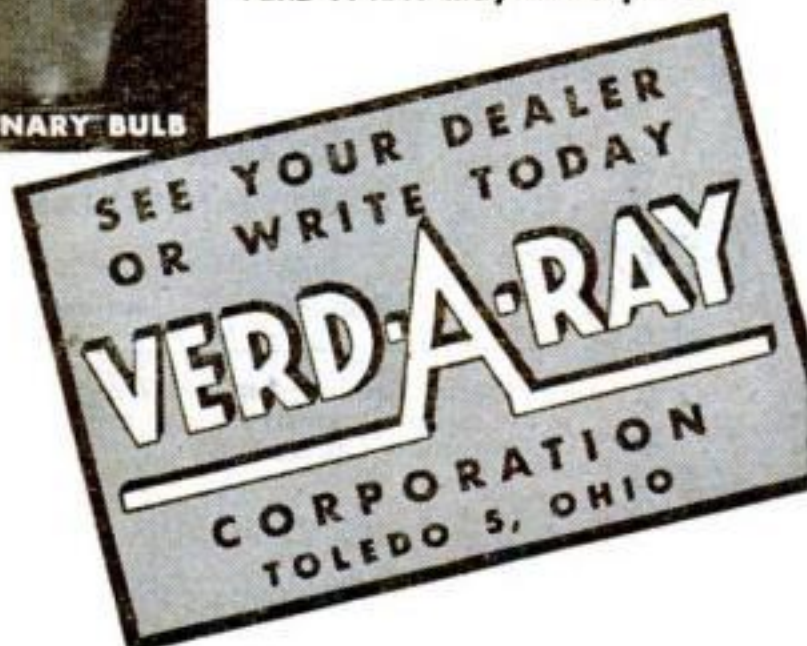


ORDINARY BULB

Scientific research data indicates improved visual (sharpness) acuity, relief from eyestrain and reduced glare.

Many war plants use VERD-A-RAY; one such plant reporting in a trade paper that hospital treated headaches were reduced 69.13%, hospital treated minor accidents were reduced 54%, and 357 productive manhours were saved in one department in one month after proper installation of this new "glareless" lamp.

Nothing to buy. Your dealer has entry form and rules of contest. If not, write direct. Any combination of six words or less, descriptive of VERD-A-RAY may win a prize.



New Era in Bombing

(Continued from page 222)

and turned about to go home. Most fighters begin getting sloppy on the controls at 30,000 feet. The air is thin; ailerons, elevator, and rudder respond sluggishly to the stick. In contrast, the B-29 is almost as well-behaved at high altitude as it is at sea level.

Jap flak gunners misjudge both the speed and altitude of the B-29. The Intelligence interrogation forms made out after a raid often record that the AA was "low and trailing."

The new techniques that I have mentioned cover a multitude of things that, for security reasons, cannot be described. But I can say that a rapid-fire camera, connected with the bomb-sight mechanism, gives A-2 a running pictorial account of a raid when the planes have returned to base. It starts shuttering a given number of seconds—depending on altitude—after the shackles release the bombs, and it keeps recording the results until the plane banks for the return home.

These new techniques include a division of labor inside the airplane made necessary by its bulk and complexity and its occasional assignment as a lone-wolf bomber. The copilot is a competent meteorologist. The bombardier is a navigator, the navigator a bombardier. The radio man is a radio mechanic. The flight engineer is an engine and airplane expert. Two of the gunners are good mechanics. One of the gunners is a highly trained first-aid man.

In case of a forced landing the crew can make even major repairs, including engine dismounts and overhaul. In its capacious belly a B-29 can tote a couple of spare engines on a relief mission to another field. It is no secret that B-29's have been flying their own fuel over the Hump, and to see a ship disgorge 10 tons of gasoline is no novelty.

To judge fully of the effectiveness of the plane as a bomber, it is necessary to assess as well the by-products of its extreme range. On the first Anchan mission, directed at the great Manchurian coke ovens, a first-degree alert was sounded along all of coastal occupied China from Shanghai north, and around the Yellow Sea through the Korean peninsula, not to mention throughout Japan proper.

The Japs didn't know where we were going. The force flung at them was large, and, for all they knew, portions of it could be splintered off to strike simultaneously at targets in an area of thousands of square

(Continued on page 232)

MORE PLANE FOR YOUR MONEY



BY "MORE PLANE" we don't necessarily mean a bigger or heavier plane for less money. We mean finer performance, greater stability and longer cruising range—more genuine owner satisfaction.

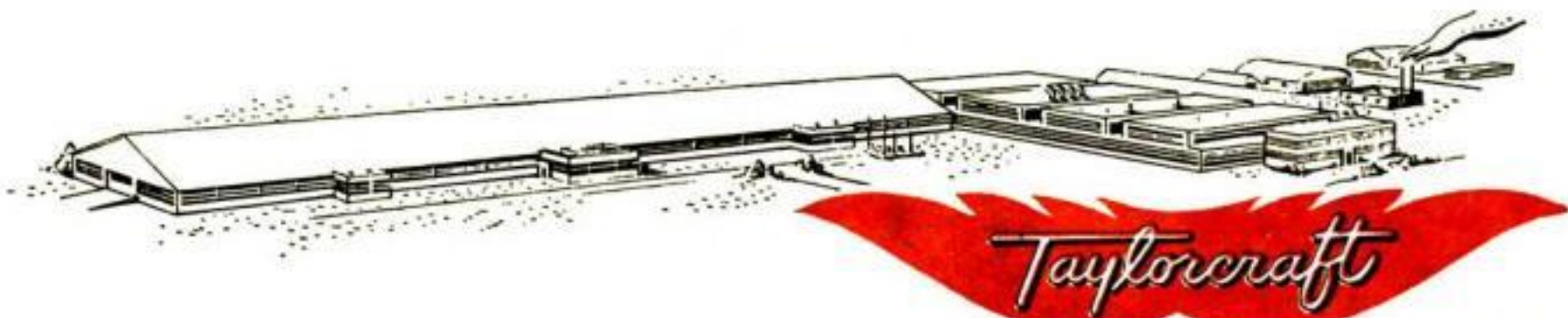
But don't take our word for it! Ask any Taylorcraft owner at your local airfield—he'll tell you how it can outfly and outclimb any plane in its class.

And he'll give you scores of other reasons that will substantiate our statement—Taylorcraft—

more for your money.

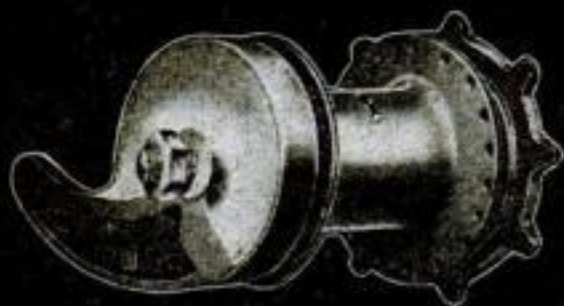
The new Taylorcrafts will be well worthy of the reputation established by earlier models. Valuable experience gained through the building and designing of Army and Navy light planes in large volume, and the availability of newly developed materials will contribute greatly to the performance of your postwar Taylorcraft.

Our aim is to deliver to a peacetime America, in the future as in the past—more flying for your money.



World's Largest Builders of Side-by-Side Airplanes

TAYLORCRAFT AVIATION CORPORATION • ALLIANCE, OHIO



First Bicycle Coaster Brake



First Yellow Taxicab



First Engine with
Cylinders Cast en Bloc

Famous "Firsts"

by NEW DEPARTURE

● The name New Departure aptly describes an organization whose thought and action has even been in advance of its time.

A partial record of the "new departures" by New Departure is reported on this page.

Well over 250 million New Departure ball bearings are in this war, and we will stay with this task until the job is done.

Such an unprecedented demand is an index of ball bearing efficiency in bearing the loads, maintaining precise location of moving parts, reducing friction and wear, for all peace-time mechanism.

New Departure, Division of General Motors, Bristol, Connecticut. 3319



First Dual-Purpose
Ball Bearing



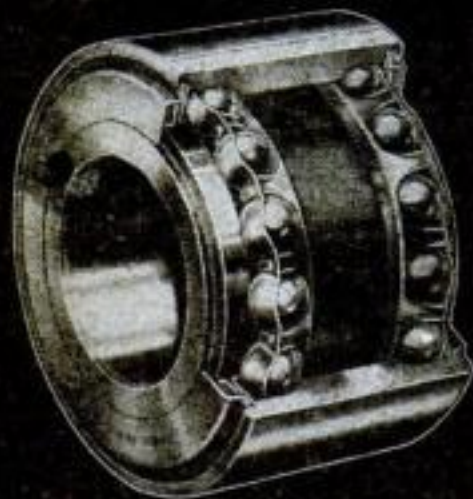
First Self-Sealed Bearing
Lubricated-for-Life



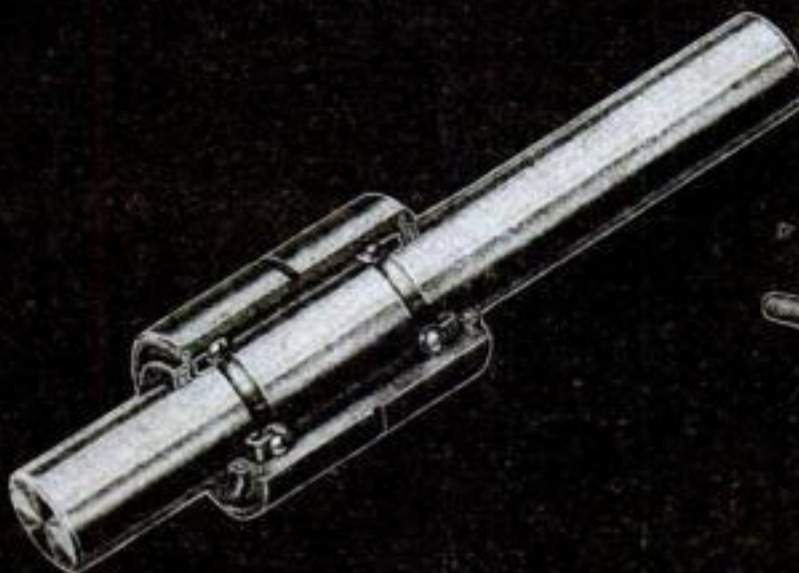
First Conveyor Roll Bearing



First Successful
Treadle Roll Bearing
for Textile Looms



First Self-Sealed
Lubricated-for-Life
Mine Car Bearing



First Pump Shaft Bearing
Self-Sealed and Lubricated-for-Life

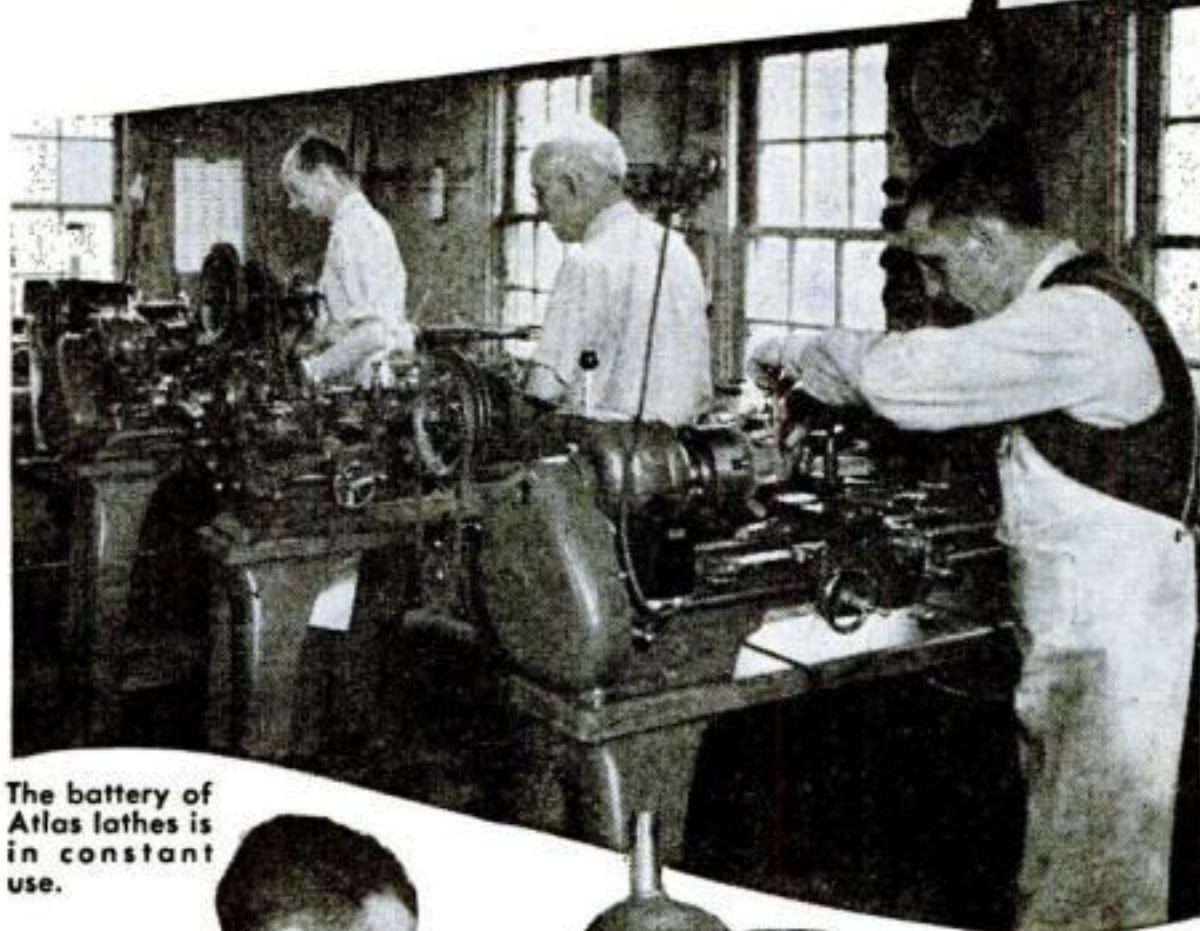


Rockwell Hardness Tester

Success WITH Atlas



There are many jobs for the Atlas milling machine in the ABC Tool and Die Co.



The battery of Atlas lathes is in constant use.

HOME WORKSHOP BASIS OF SMALL BUT VITAL WAR PLANT

One day's work a day wasn't enough for Mac Milligan and Jack Ryan, Rochester, N. Y., when the Axis took on Uncle Sam. So the two veteran machinists pooled their home shop resources . . . an Atlas lathe, milling machine, shaper, and drill press . . . and began making tools and dies in their spare time.

Soon Mac and Jack had to spend full-time on their business which they named the ABC Tool and Die Company — and one by one retired machinist friends offered to pitch in and help. More machines were purchased . . . including four more Atlas lathes . . . and the plant force grew to sixteen men with thousands of vital precision products to their credit.

What these two patriotic Americans did is typical of the efforts of many hundreds. In small shops and home workshops, Atlas tools pointed the way to profitable after-hours work that grew into a thriving business. Be sure to find out about low-cost, compact Atlas tools for your postwar shop!

**NEW PATTERN
SERVICE for
WOOD CRAFTS-
MEN see Atlas
ad page 269**

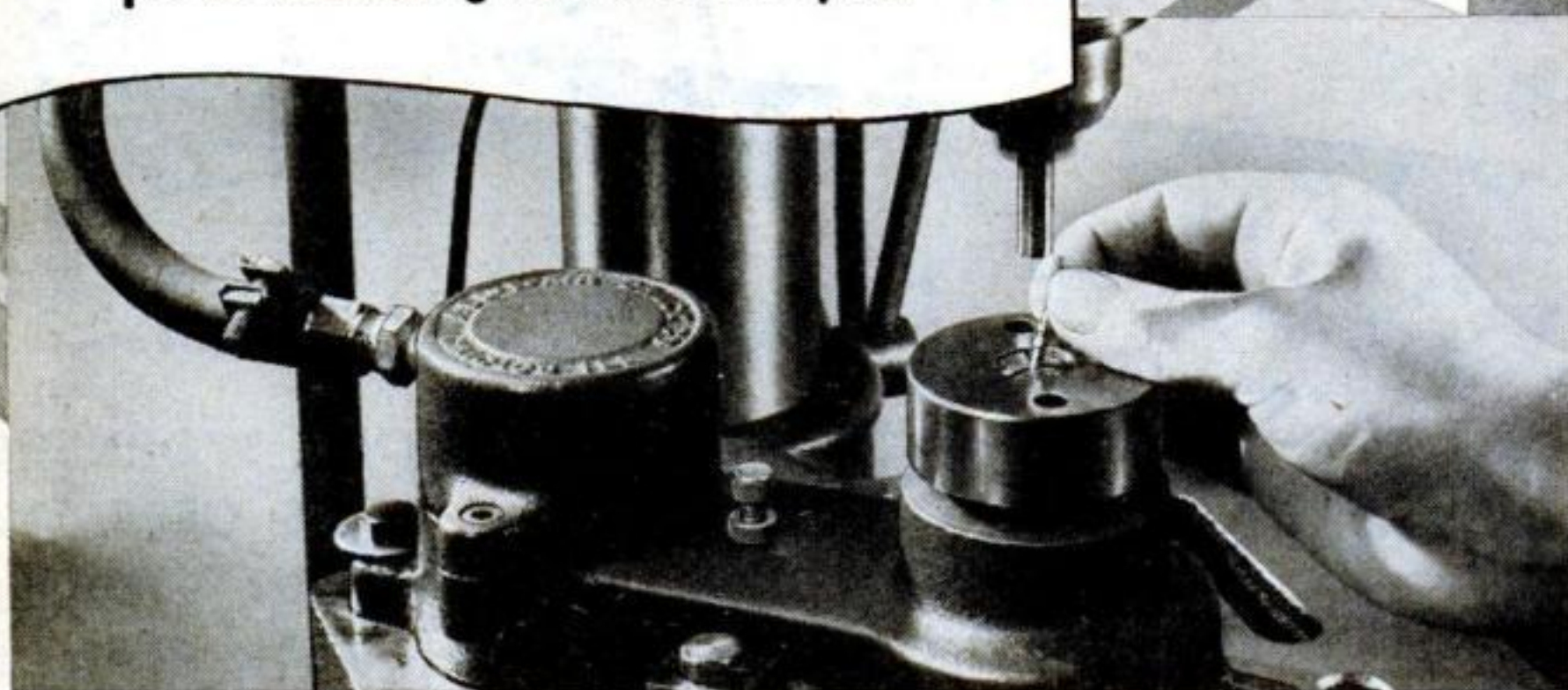


There is plenty of precision drilling for the Atlas floor model drill press.

ATLAS PRESS COMPANY
1155 N. PITCHER ST., KALAMAZOO 13D, MICHIGAN

Ingenious New Technical Methods

Presented in the hope that they will
prove interesting and useful to you.



Now—Air Operated Collet Chuck Relieves Second Operation Work on Screw Machines

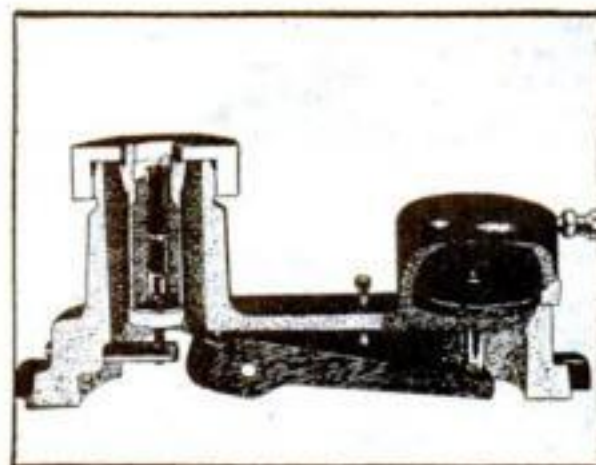
Work formerly requiring automatic or hand screw machines can now be done at much less cost through the combination of this new air chuck and any drill press. The Redmer Air Chuck is a collet air chuck using standard Brown & Sharpe type screw machine collets. The collet remains stationary, the opening and closing controlled by a sleeve action.

By using a collet as the chucking means, slight variations in the diameter of the work as frequently experienced with automatic and hand screw machine products can be permitted without sacrificing accuracy or concentricity. Thus accomplishing an important saving in time and cost.

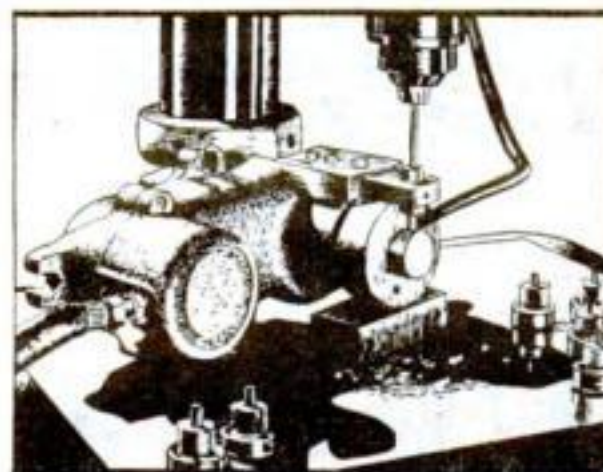
The air chuck is an ideal tool for holding parts for drilling, milling, slotting, burring, chamfering, boring, counterboring, tapping, threading, reaming and other work where the machine operation should be concentric with the chucking surface. It is adaptable to many different jobs merely by changing collet and stop. This results in saving of valuable production metals and materials. The chuck will take any type work whether round, hex, square or rectangular, and permits full efficiency of the operator, as it is operated by a foot operated valve thus leaving hands free to load and unload—reducing fatigue and cutting unproductive time to a minimum.

Wrigley's Spearmint Gum, too, is a help on the job. For chewing gum helps relieve dry throat, and helps ease fatigue brought on by the strain of work. And at the same time you are chewing and getting the benefits of swell tasting Wrigley's Spearmint, both hands are free and you need not take a "time out." The Army and Navy have recognized these benefits and are now shipping overseas *only*, all of the limited production of Wrigley's Spearmint. When Wrigley's Spearmint can again be produced in sufficient quantity for all, the valuable benefits of Wrigley's Spearmint Gum now being proven on the battlefield will apply to industry here at home.

You can get complete information from Redmer Air Devices
Corp., 601 West Washington Blvd., Chicago 6, Ill.



An air operated collet holding
fixture for precision chucking
or machine tools



Chuck can be mounted on angle
for angle milling job

Y-154



Let Aeronca show **YOU** how to get ready to do
BIG BUSINESS with a SMALL AIRPORT!

Do you want to get into the real money making end of aviation, the coming new industry—in business for yourself? You can be independent—your own boss—running your **OWN AIRPORT**.

Now—today—*you* can start getting ready to make big profits in aviation! You need no fancy set-up, no big cash outlay. But you *do* need the "know how", and *only* Aeronca offers its dealers a *complete profit-making program!* Tells you things you must know to make money with a

small airport; to whom and how to sell Aeronca planes, how to make your field "flying headquarters" and many other things you'll want to know.

Aeronca's *complete* dealer program is based on more than 16 years experience in leadership of the personal plane field. It can start *you*, as it has started others, on the road to success and profits through small airport operation!

Ask Aeronca for the facts—now. Send for illustrated booklet today. Use the coupon.

MAIL THIS COUPON! GET THIS BOOKLET NOW!



 The Only Light Aircraft Company to Receive the Army and Navy "E".

AERONCA
 AIRCRAFT CORPORATION
 MIDDLETOWN, OHIO

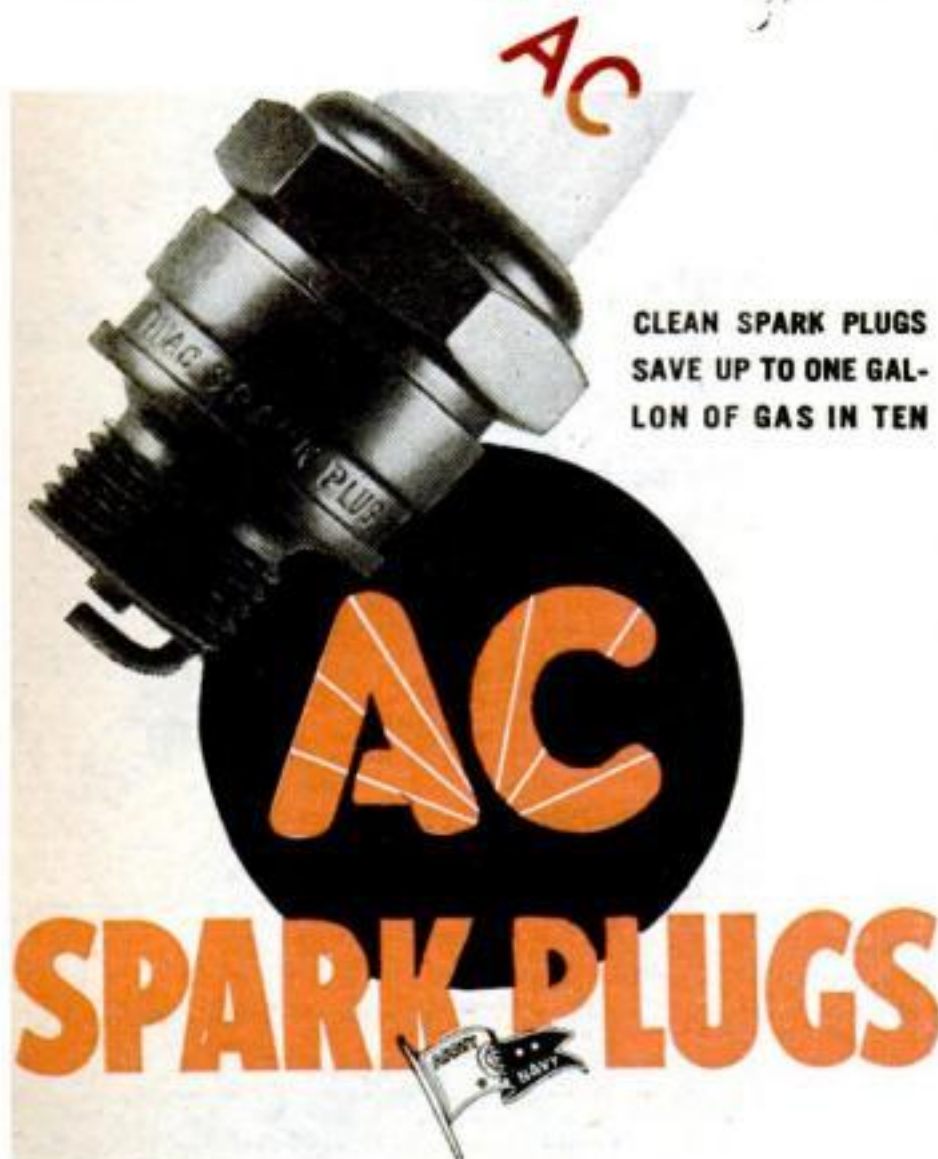
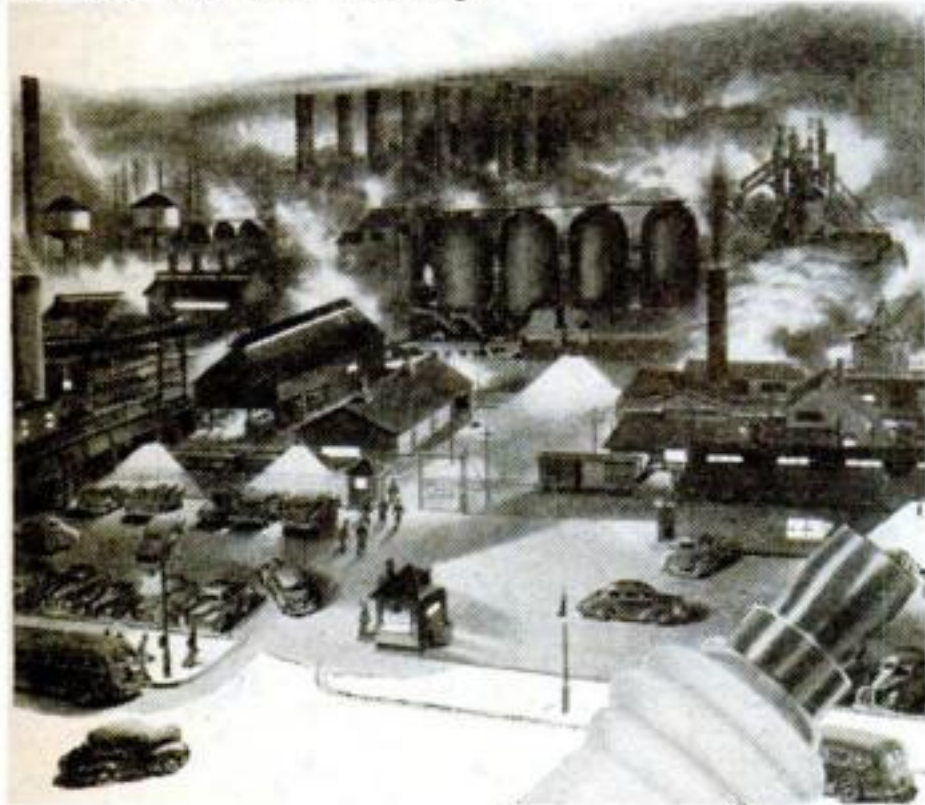
Al Bennett, Director of Sales,
 Aeronca Aircraft Corporation, Middletown, Ohio.
 Send me your valuable booklet on "Why You Should Be An Aeronca Dealer". I enclose 10c.

Name.....

Address.....

City and State..... **W-11**

Night shift or day shift, the steelworker's car must be always ready. Thousands of those "front line" workers insure utmost reliability in spark plug performance by having their plugs cleaned and adjusted every 3,000 miles, and by replacing worn plugs with new AC's. That's a good rule for everybody, because it saves gas, oil, and vital materials for an earlier Victory.



BRING YOUR FIGHTING MAN HOME SOONER
BUY ANOTHER WAR BOND THIS MONTH

New Era in Bombing

(Continued from page 226)

miles. First-degree alerts cut down the enemy's industrial output.

As an aircraft the B-29 is a versatile machine. On one raid the pilot of a Superfortress, unhappy about his position in relation to the target on his first run, and again on his second, made a third try.

"I pulled her around with no trouble at all," he said. "She handled like a fighter."

In a raid on Nagasaki we cascaded incendiaries on the Kyushu Island naval installations. While it would not be good Intelligence to let the enemy know what we know about the effectiveness of our raids, it can be disclosed that a brace of B-29's enjoyed the results of that visit so much that they stooled around too long watching the show. That left them short of fuel and they had to make intermediate landings on grass-surfaced fields with runways less than half the length of those at their home base.

The incident stilled once and for all the allegation that the B-29 had to have a runway as big as all outdoors to get off the ground. Those rock-and-slurry (mud) runways that we use were built long partly to reassure the crews of our heavily-laden bombers and partly to reduce the chance of operational losses.

In the beginning the crews were worried about the pressurized interiors. They thought that if the fuselage got a hole in it anything might happen. (See page 136.) I have seen a B-29 come home after several hours at high altitude with a nine-inch hole in the skin and still with sufficient pressurization to obviate the need for oxygen masks. The superchargers have plenty of excess capacity.

Emergency rubber patches are provided for bullet holes, but one crew, receipting for .50 calibers from a Jap fighter that stood off at a respectful distance, prankishly patched the ship with cheese from their sandwiches to see if it would work. It did.

So far as we know, the Japs don't have a very clear idea as yet of the kind of weapon being used on them. In one broadcast they described it as a "large-type bomber of 42 tons, of an extensive cruising radius and equipped with four-motored engines." That's a rough idea—quite rough.

Radio Tokyo has called the B-29 "fragile." The ship has been landed wheels-up in a dry river bed and been back in action within a week. One Jap commentator said the plane was made of shoddy, ersatz materials.

(Continued on page 240)

For Men who Really Know Pipes



Selected Briar **\$1.50**



THIS IS NOT A MIRACLE-PERFORMING PIPE . . . Royalton Crown has no mystic gadgets—no secret elements to make a poor tobacco taste wondrously fragrant . . . But it *does* have SIX PATENTED FEATURES that make it the only pipe of its kind—a pipe that STAYS EVERLASTINGLY DRY . . . Condensing well traps bitter slugs and juices, assuring an ever-dry bowl and an ever-dry mouthpiece. Special construction permits efficient cleaning.

HENRY LEONARD & THOMAS, INC., OZONE PARK, N. Y.



Caught in the Widow's Web . . .

Boring into the inky blackness, the P-61 Northrop Black Widow ferrets out the enemy with an electronic eye and delivers a torrent of cannon and machine gun fire.

As hefty as a light bomber, but with the agility of a single seat fighter — that's the "Black Widow." Like most other outstanding U. S. fighters*, the P-61 uses Curtiss Electric Propellers.

* P-38 Lightnings, P-47 Thunderbolts, P-40 Warhawks, P-51 Mustangs, P-39 Airacobras and Navy F4F and FM-2 Wildcats.



CURTISS ELECTRIC
PROPELLERS

Curtiss-Wright Corporation • Propeller Division

America's Number One Manufacturer of Warm Air Heating Plants Announces

A NEW KIND OF FURNACE DESTINED TO SWEEP AMERICA!

COSTS LESS!...MORE EFFICIENT!...AMAZINGLY COMPACT!

ALREADY PROVED IN THOUSANDS OF HOMES!

FLOOR-LEVEL AIR DRAWN OFF HERE—QUICKLY WARMED—MEANS WARM FLOORS.

AIR INTAKE CHAMBER SPREADS AIR INTO HEATING CHAMBER.

AIR IS WARMED AND CIRCULATED 3 TO 5 TIMES AN HOUR IN AN AVERAGE 5-ROOM HOUSE.

STREAMLINED BOTTOM MAKES AIR "FLY" 35% FASTER THROUGH THE FURNACE!

80% OPEN REGISTER SPEEDS WARMTH TO EVERY CORNER OF YOUR HOME.

COMPLETELY AUTOMATIC! NO DIRT, ASHES, SHOVELING OR WORK.

NEEDS NO BASEMENT—NO DUCTS. AIR-FLOW PRINCIPLE GIVES BETTER COMFORT.

GET THE WHOLE STORY OF THIS "HEAT OF TOMORROW" FROM THIS FREE BOOK!

FREE!

The "INSIDE STORY" about this and other "magic" heat plants.

IT'S CALLED A "FLOOR FURNACE"—BECAUSE IT IS SET IN THE FLOOR!

Here is some of the practical Coleman heat-magic you can have after the war. New "warm-floor" comfort—automatic effortless ease—surprisingly low fuel cost. One of a group of advanced heating plants, perfected by Coleman engineering genius. Gas, oil, butane models will be available.

A book of solid facts about the different type of heating that will be available when production is resumed. Mail coupon for your copy, to Coleman Lamp and Stove Co., Dept. SM-625, Wichita 1, Kansas.

**THE "HOT" NAME
IN HOME HEATING**

Coleman

THE COLEMAN LAMP AND STOVE COMPANY
WICHITA 1 • CHICAGO 11 • PHILADELPHIA 8 • LOS ANGELES 54

THE COLEMAN LAMP & STOVE CO.,
Dept. SM-625, Wichita 1, Kansas.

Without obligation, send me your FREE illustrated book,
"The Inside Story of Tomorrow's Home Heating."

Name _____

Address _____

Town _____ State _____



PIONEERS FOR 80 YEARS

Ever since the Civil War, Stevens has pioneered new developments in sporting arms and new and better ways to make them.

LOOK TO STEVENS FOR THE GUN YOU'LL WANT

Are you thinking about a new gun for postwar hunting, target shooting or just plain and fancy "plinkin'?" Then look to Stevens for the best buy in a rifle or shotgun.

Right after war restrictions are lifted, you'll be able to pick from a wide variety of Stevens-built models. They'll have all the fine features you'll be looking for—at surprisingly moderate prices. You'll find them outstanding in value—the result of Stevens' long experience, sharpened by Victory production of military arms in great quantities.

Thousands of shooters own Stevens Springfield Brand single and double barrel shotguns and .22 rifles. These extremely popular models will again be available. And so will the newer Stevens models like those illustrated below.

J. Stevens Arms Co.
Division of Savage Arms Corporation
Chicopee Falls, Mass.



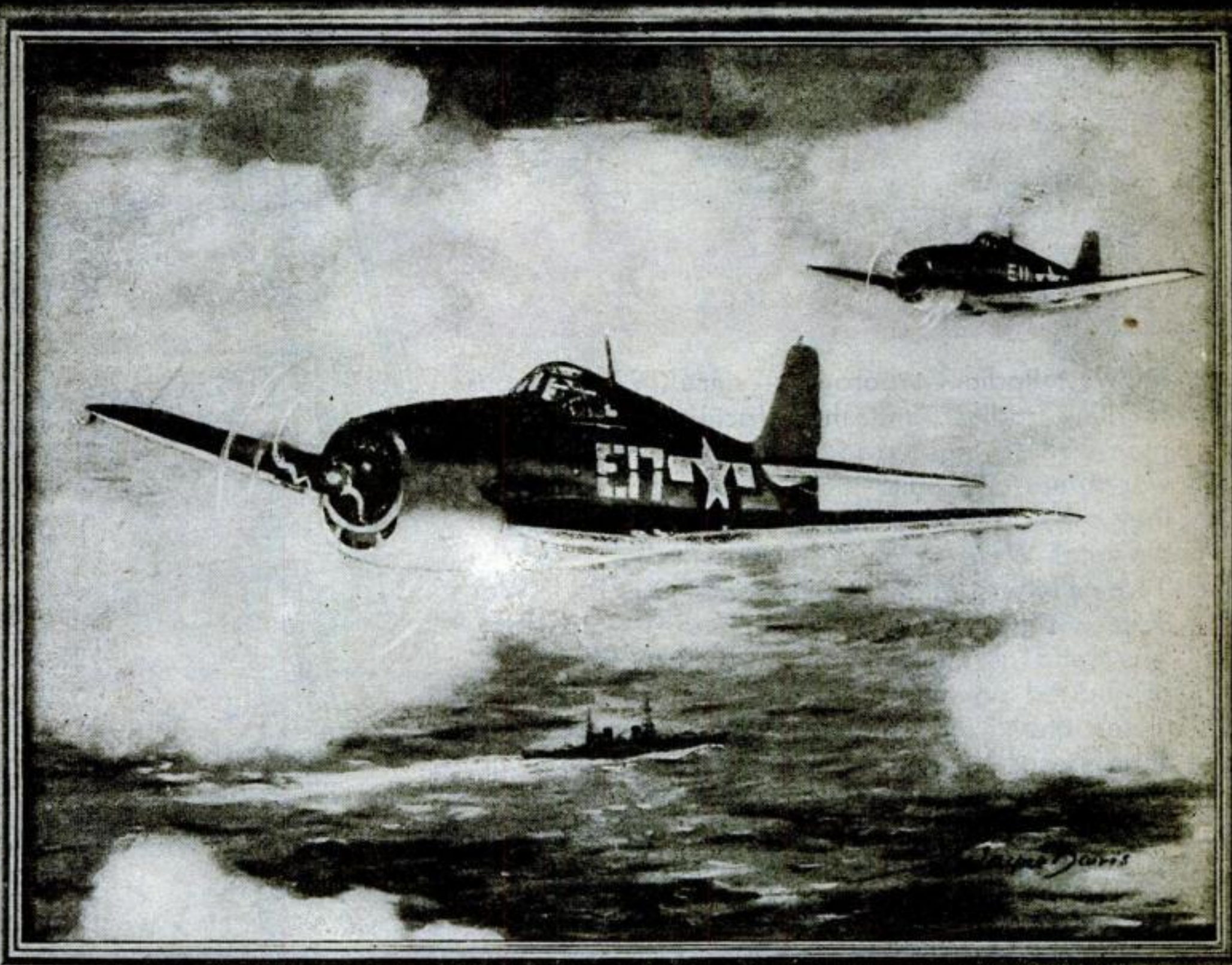
Stevens No. 22-410
Over-and-Under .22 Rifle
and .410 Shotgun. Afield with
this combination gun, you're
ready for all kinds of small
game and vermin.



No. 87 Springfield Brand
3-in-1 Automatic .22 Rifle.
Adjustable for automatic load-
ing, hand-operated repeater,
or single shot.



STEVENS



U. S. Navy's Grumman Hellcats in Action off Saipan

Grumman

AIRCRAFT ENGINEERING CORPORATION, Bethpage, L. I., N. Y.

Copyrighted material

Win WAR BONDS

A GRAND TOTAL OF

\$1,000.00

IN PRIZES *for Your Ideas*

Midwest Radio Corporation—since 1920, famous for fine radios, and their factory-to-you selling plan with savings up to 50%—looks to the post-war future. To build the kind of radio you want, they ask you now to submit a letter on the subject: "What I Want In My Post-War Radio." For the 11 best letters, Midwest will give \$1,000.00 in War Bonds. Letters must not exceed 200 words and you may send as many entries as you wish. Letters will be judged on the practical value of the ideas contained therein and the decision of the judges will be final. In case of ties, duplicate prizes will be awarded. All entries must be postmarked not later than midnight Dec. 31, 1944. Contest open to all except employees of Midwest Radio Corporation, their advertising agency, and members of their families. Winners will be notified on Jan. 31, 1945. Prizes will be awarded as follows:

First Prize \$500 in War Bonds
Second Prize . . \$200 in War Bonds
Third Prize . . . \$100 in War Bonds
and eight prizes of a \$25 War Bond each.

Send your entry to Contest Editor at
MIDWEST RADIO CORP., Dept. 59 J, Cincinnati 2, O.



MIDWEST RADIO

*

*

WANTED:

Engineers with talent in
tooling, machine design,
precision assembly
methods . . .

The United States Time Corporation—the world's largest watch-
makers—are making precision instruments for war.

For this big job, we need engineers. Engineers with talent in
tooling, machine design, precision assembly methods. Engi-
neers who appreciate teamwork and will share our zeal for
accomplishment. Engineers
who want *permanent* jobs.

We suggest you fill out and
mail us the attached coupon.

Ingersoll

The Most Famous Name In Time

U. S. TIME, Dept. PS
Waterbury, Conn.

Gentlemen: .

I am interested in the opportunity you offer. My field is _____

NAME _____

STREET _____

CITY _____ STATE _____

*All applications for positions must conform to the War Manpower Commission
Regulations of the Employment Stabilization Program for the Waterbury Area*

WHERE PERFORMANCE REALLY COUNTS...



... COUNT ON DEPENDABLE CHAMPION SPARK PLUGS

Add to our own vastly increased requirements for food, those of untold millions who desperately need it, but cannot now produce it, and the burden on the American farmer is staggering. Yet with the characteristic vigor of the home-front soldier that he is, and the aid of power farming equipment which multiplies his ability to produce many fold, he is meeting the need with magnificent fortitude. His car, truck, tractor, stationary engines, and the implements used in conjunction with this power equipment are literally the farmer's "strong right arm." Dependable Champion Spark Plugs, long-time favorites of farmers everywhere, play their vital part in keeping engines smooth, economical and dependable. Realizing their importance, most farmers inspect, test, and clean all spark plugs at regular intervals — install new Champions when necessary.



Finish The Fight With War Bonds
Buy More Than Before NOW!

New Era in Bombing

(Continued from page 232)

If anything, it is constructed of platinum and diamonds.


The Twentieth has had its problems. Engines have been troublesome, for one thing. That isn't their fault. We've carried as much as a 40,000-pound overload on those four Cyclones. Our distances are great and sometimes we have to. Cylinder heads burn out and must be replaced.

We are not getting away with our raids scot-free. The communiques tell of airplanes failing to return. Occasionally flak gets them. Sometimes Jap fighters making head-on attacks don't peel off fast enough, and collide. Once in a while operational losses plague us, as they plague any bomber command. But those losses are far from being prohibitive.

The men of the Twentieth believe in their airplanes, and in a long-range program of strategic bombing that is almost everything. Their welfare, their comfort, is a paramount consideration of the Command. When they clamber into their planes they are handed compartmented food containers from which dangle electric cords. There are six compartments in each, containing six meals, from soup to chewing gum. For a hot meal, all a man has to do is plug a container into the B-29's electrical system.

And on the way home from a raid the crew passes the hours enjoying Tin Pan Alley tunes, brought in by the radioman and piped throughout the ship. True, it's canned. It has been recorded—by the Japs — from broadcasts of American orchestras for a "psychological offensive" against American soldiery in Asia.

The Superfortress crews are grateful to Radio Tokyo for entertaining them while they wear down Japan's will to make war.



Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

CHAMPION

SPARK PLUG COMPANY • TOLEDO 1, OHIO



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FOR THE VITAL LINK IN **FLUID POWER**

Think of fluid power as the three-link chain: Source—Circuit—Utilization.

The Circuit is the *key link*. It may go around corners and into tight places. It may even be vulnerable. Too often it is just taken for granted.

The success of fluid power depends on the engineering of the Circuit. That is Parker's business.

We do the engineering from design through to installation. We build the valves and fittings and the tools to handle them.

Our specialized know-how distilled from twenty years' experience with Fluid Power System is at your command.

The best way to get this know-how applied to your problem is to ask a Parker engineer. Or write direct to The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.

PARKER SELECTED TO DISTRIBUTE SURPLUS WAR STOCKS OF PRECISION VALVES AND FITTINGS

Recognizing that users of precision valves and fittings would be served best by having war surpluses made available through an organization with broad application experience, Metals Reserve Company has appointed Parker to be a distributing agent. For details on type, quantity, specifications and application of this very large stock, write, wire or telephone

PARKER SERVICE AGENCY

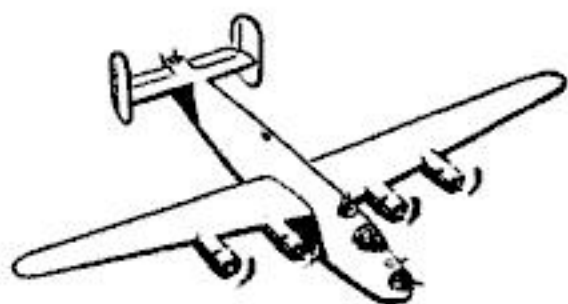
17325 Euclid Avenue Cleveland 12, Ohio

agent for

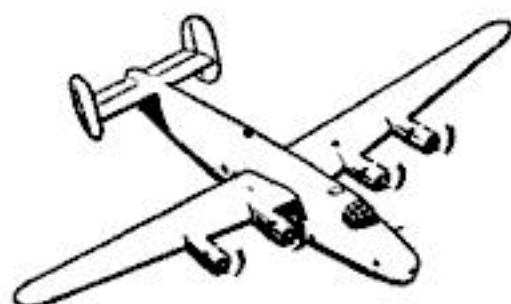
METALS RESERVE COMPANY

THE
PARKER
APPLIANCE COMPANY
CLEVELAND • LOS ANGELES

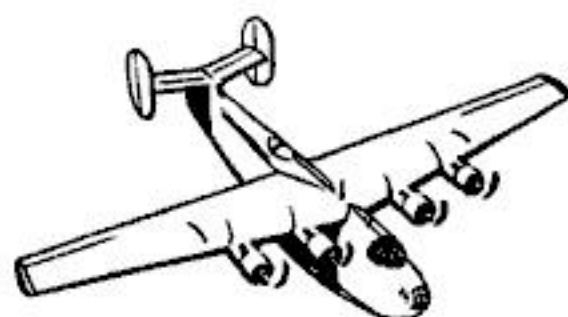
From Flying Jeeps to Leviathans of the Air



LIBERATOR . . . 4-engine bomber



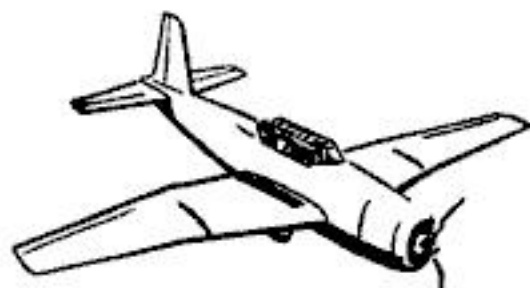
LIBERATOR EXPRESS . . . transport



CORONADO . . . patrol bomber



CATALINA . . . patrol bomber



VALIANT . . . basic trainer



VENGEANCE . . . dive bomber



RELIANT . . . navigation trainer



SENTINEL . . . "Flying Jeep"

WHEN VICTORY has been won, Consolidated Vultee Aircraft Corporation will be in a position to

provide the postwar equivalent of these planes, from small "air flivvers" to trans-oceanic cargo-and-passenger planes.

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Louisville, Ky.
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Member, Aircraft War Production Council

**"THANKS FOR YOUR
LEAKPROOF BATTERIES!"**



... They helped knock over this enemy tank

These little batteries you haven't been able to buy for your flashlight have been powering tank-busting bazookas, flame-throwers, field telephones, flashlights, and hundreds of other war weapons. You miss these Leakproof batteries, of course, but remember, millions of our fighting men thank you for giving them up.



**THE FLASHLIGHT BATTERY THAT
STAYS FRESH FOR YEARS
BECAUSE IT'S LEAKPROOF**

Ray-O-Vac is the only flashlight battery that's sealed-in-steel. This means it stays fresh far longer than ordinary batteries... that vital power is there when you need it. It's the only battery guaranteed never to cause corrosion damage to your flashlight. Watch for Ray-O-Vac LEAKPROOF'S return to the consumer market after Victory.



FLASHLIGHTS



BATTERIES

RAY-O-VAC COMPANY, MADISON 4, WIS.; Other Factories at CLINTON, MASS.; LANCASTER, OHIO; SIOUX CITY, IA.; FOND DU LAC, WIS.; MILWAUKEE, WIS.

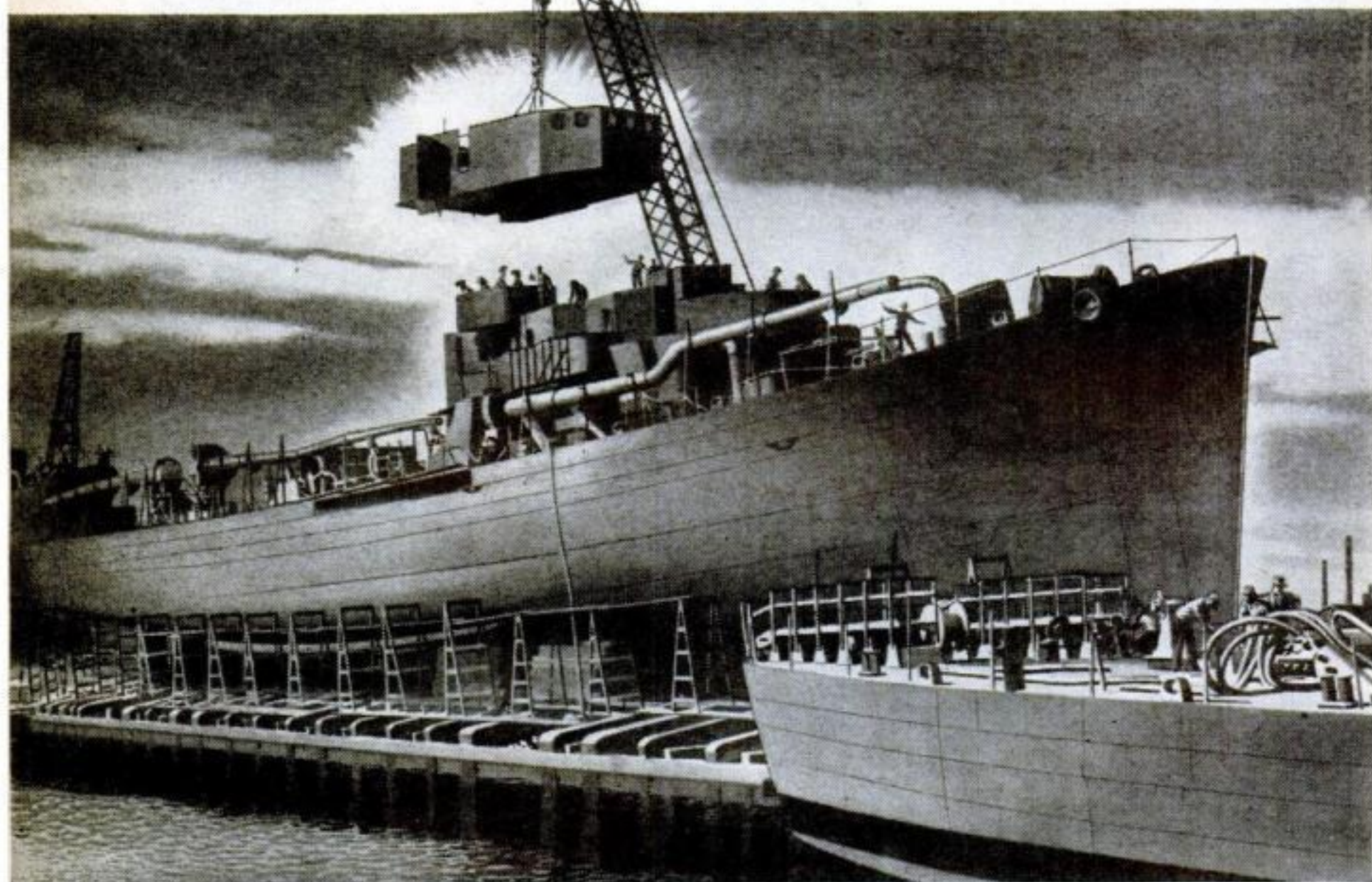
NOVEMBER, 1944

Buy War Savings Bonds and Stamps regularly.

243

Crown of

steel for a queen



As significant in its way as the coronation of an earthly monarch, is the placing of the steel superstructure that crowns a queen of the sea. ☆ And surely a fine ship is queenlike, for she possesses regal beauty, proudly defies the wind, the weather and the sea and gives royal guardianship to the men who sail her. ☆ These qualities are imparted to a vessel by the shipbuilders—men who build with their hearts as well as their arms. Theirs is both an art and an industry—a craft and a science. ☆ For nearly forty years, Defoe has been building and *crowning* queens of the sea. Yesterday, beautiful yachts and hardy small craft came from the Defoe ways. Today, fighting ships for the Navy. Tomorrow, for peacetime America, Defoe will build private vessels and industrial products that reflect the skill and devotion typical of the shipbuilder's art. This is the only way we know how to build.

DEFOE SHIPBUILDING COMPANY, BAY

CITY, MICHIGAN

BACK THE ATTACK
—BUY WAR BONDS



Four White Star Renewal Citations
now decorate the Navy "E" Award
won by Defoe workers.

SHIPS FOR VICTORY
SERVANTS FOR PEACE

Two miles up - with an ear to the ground



Keeping posted high in the air is one secret of successful flying. The ground keeps track of the plane. The plane knows the weather, the course, and what it's like at the field.

Lear was among the very first to make aircraft radios — had gained an enviable reputation for fine radio and navigation instruments long before the war — was ready when war needs demanded greater and greater technical development.

Some of these developments can't even be mentioned now. They're too secret. Some are in the field of electric aircraft con-

trols. Some will have no use outside of war.

But there are others that hold vast promise for everyone when peace returns.

With its war job done, Lear will turn its discoveries, its developments, the resources of its laboratories and plants toward adding new comforts, new conveniences, new pleasures to the lives of America's families.

PLANTS: Piqua, O., and Grand Rapids, Mich.
BRANCHES AT: New York, Los Angeles, Chicago, Detroit, Cleveland



A tank will burn for 24 hours!



Crash truck — ladies' size! Scooters, "manned" by women, rush to fires at air fields and snuff out blazes with Kidde carbon dioxide fire extinguishers.

VOLATILE fuels used in high-powered tank engines make fire a constant threat to tanks! But on *our* armored giants, first lick of flame sets off a warning signal, the driver reaches for lever and blaze is smothered instantly under a blanket of carbon dioxide snow-gas. Kidde designed this system especially for tanks.

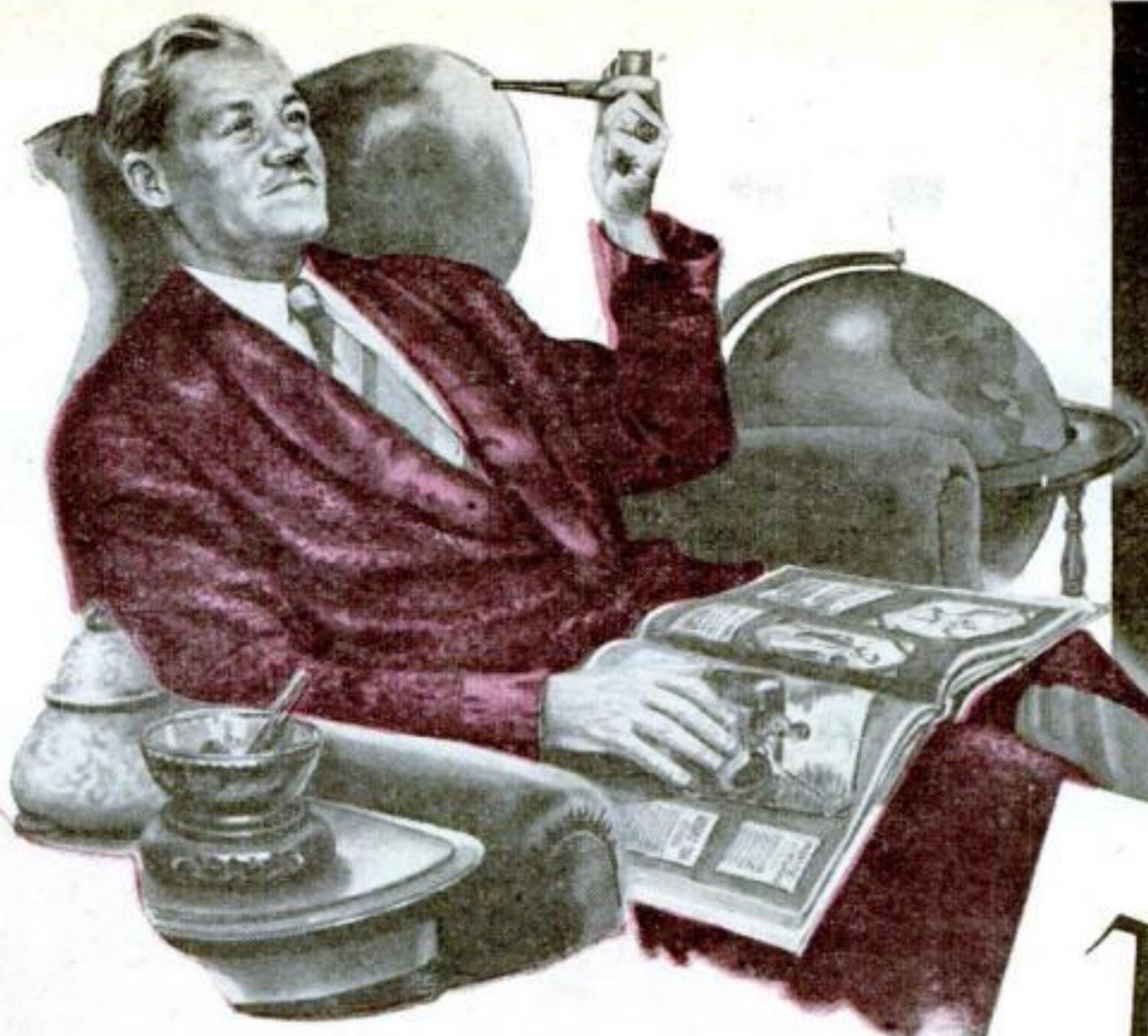
Screen for invasion! To cover landings, planes lay barrage of smoke. Carbon dioxide from Kidde cylinders forces chemical out of tanks to form the smoke-screen.



Gases-under-pressure, harnessed by Walter Kidde & Company, are serving our fighting men in many ingenious ways. After the war they'll serve you. Look for them!

WALTER KIDDE & COMPANY, INC., 140 CEDAR ST., NEW YORK 6, N. Y.



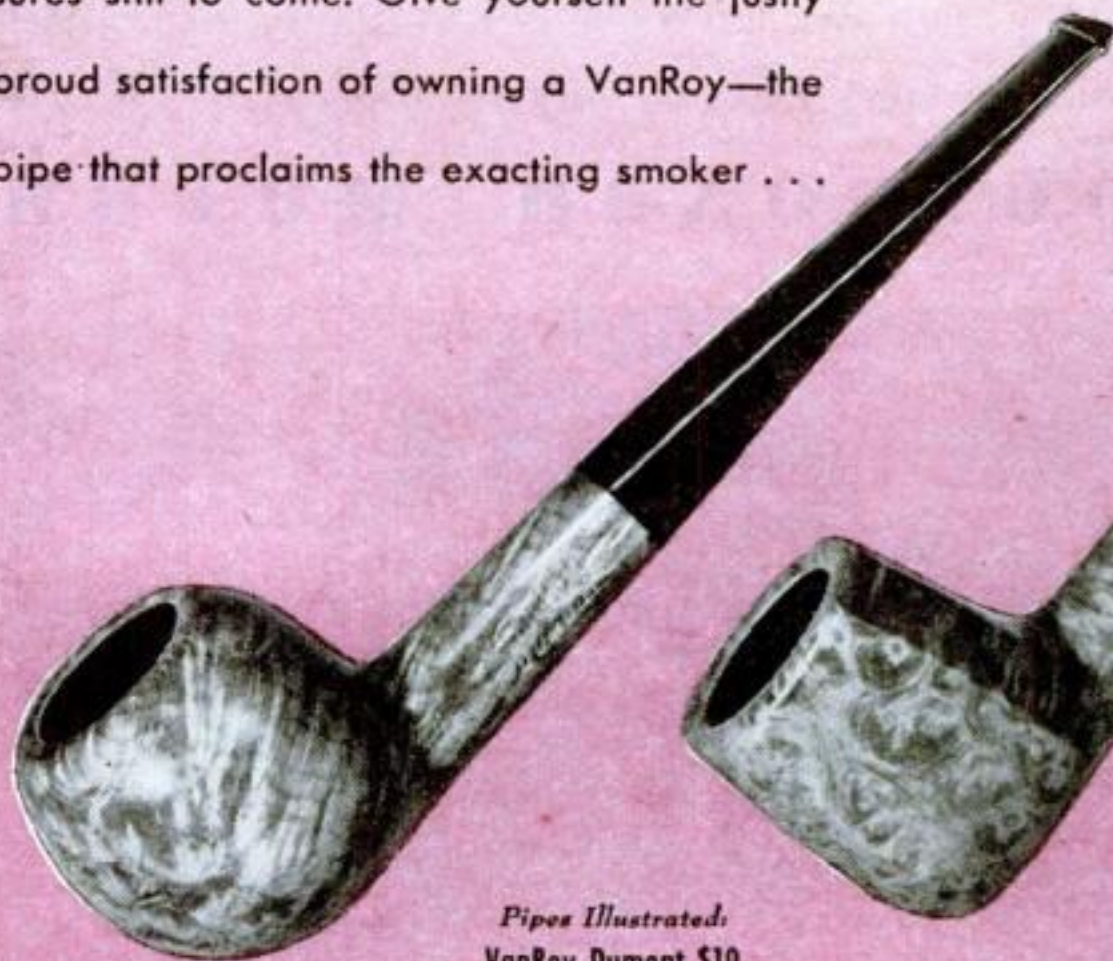


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in Pipes*



VanRoy

Men treasure the VanRoy Pipe for the trail of memories it leaves of past enjoyments—and for its unfailing promise of new pleasures still to come. Give yourself the justly proud satisfaction of owning a VanRoy—the pipe that proclaims the exacting smoker . . .



Pipes Illustrated:
VanRoy Dumont \$10

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EMPIRE STATE BUILDING
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VanRoy Pipe Family—ARISTA 3.50 • BARD 5.00 • COURIER 7.50 • DUMONT 10.00



BY CONTRAST they seem worlds apart . . . the spectacular Evinrude "quads" that drive these swift assault craft . . . and the peaceful "fishing" Evinrudes that every sportsman knows. But the big motors in olive drab owe much of their great performance to the peacetime Evinrudes that came before . . . to more than 30 years of concentration on building *pleasure motors* better and better . . . lighter and more powerful . . . ruggedly reliable and trustworthy. In stepped-up measure these qualities are built into the Evinrudes that serve on battle fronts today. After Victory they will again be yours . . . in new Evinrudes designed for your greater enjoyment of every hour you spend on the water! *Evinrude Motors, Milwaukee 9, Wisconsin.*

EVINRUDE OUTBOARD MOTORS



BUY MORE WAR BONDS . . .

. . . HOLD WHAT YOU HAVE



THE CHAMPION, TOO,

LOOKS DIFFERENT NOW

Remember the roaring motor, the cheering crowds as the champion sped around a breath-taking curve. To-day he drives to a newer, greater kind of victory wearing a service uniform. He looks less colorful, yes, as do the champions in every line. Plumb, too, has donned a service uniform.

Because of Government limitations some of the finish is gone from Plumb tools. But you'll recognize Plumb quality by the hang, the perfect balance, the long life of the tempered steel head and the snug comfortable grip of the handle—and, above all, the untiring ease with which it works. These features are part of every Plumb tool. Fayette R. Plumb, Inc., 4837 James Street, Philadelphia 37, Pa.



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This Amazing

**"NEW
POCKET"
STOVE**

*Used by All Branches of
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**Burns the Same Fuel
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Today, you cannot buy this new "Pocket" Stove. Originally designed by Coleman, it is exclusively built for the use of the armed forces.

When peace comes, this compact, amazing, little magic stove will double the joy and convenience of millions of picnickers and sportsmen. Easy to carry as a thermos bottle or flashlight. Only 8½ inches high, 4½ inches in diameter—yet the "hottest" little cooker

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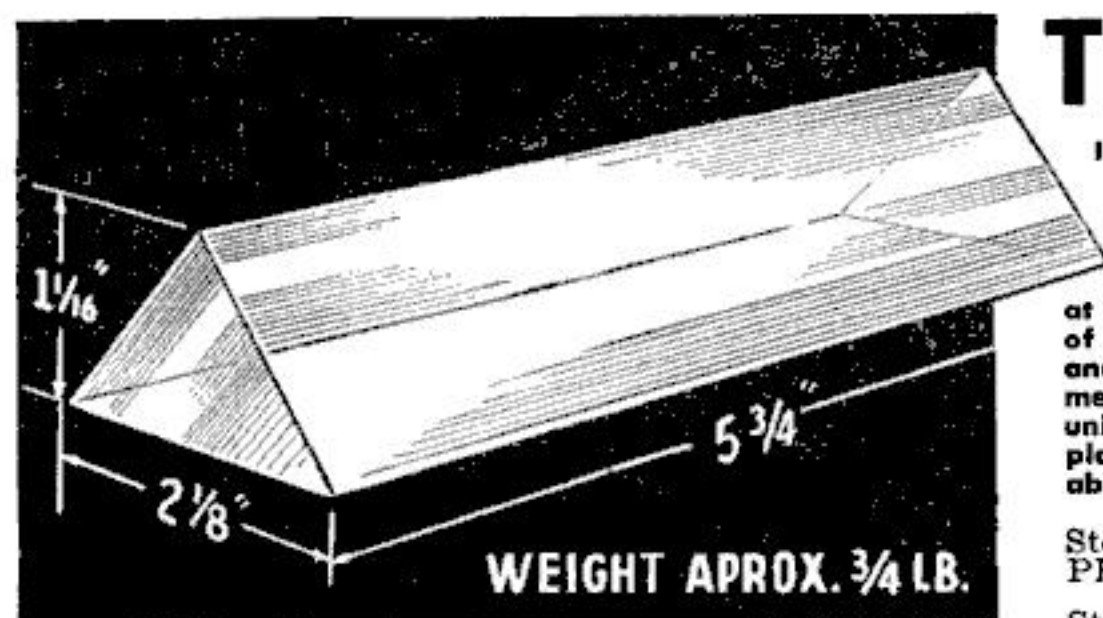
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All Neatly Packed and Marked**

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In order that the tank driver shall not get shot in the face, two of these Silvered Prisms are used to make a periscope (without magnification).

We have secured a number of these that are very slightly chipped, making possible their sale at a very low price. They are 90-45-45 degree prisms of huge size— $5\frac{3}{4}$ " long, $2\frac{1}{8}$ " wide, finely ground and polished. Other uses for these Prisms: Experimental Optics, Optical Instruments and Gadgets, as unique gift item, unusual paper weight, desk name plate, etc. Normally these Prisms would retail from about \$24 to \$30 each.

Stock No. 3004-N . . . SILVERED TANK PRISM—Price \$2.00 each Postpaid.

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Cut Heat Losses**



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Easily, Without Tools!**



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You simply press Kalk-Kord in place with fingers alone, no guns or other tools needed. It is non-oxidizing and will not

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Kalk-Kord is packed in convenient rolls, ready for use. It is neat and clean to work with, cannot stain. Users everywhere are enthusiastic about Kalk-Kord. Try it yourself, now.

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The scientific combination of oily waxes in Shinola provides a protective pliable film which helps repel water, dust and grime. Applied and finished like any other wax, Shinola waxes buff to a quick, brilliant shine. Swell for leather and linoleum, too... Shinola is the largest selling paste polish in America.

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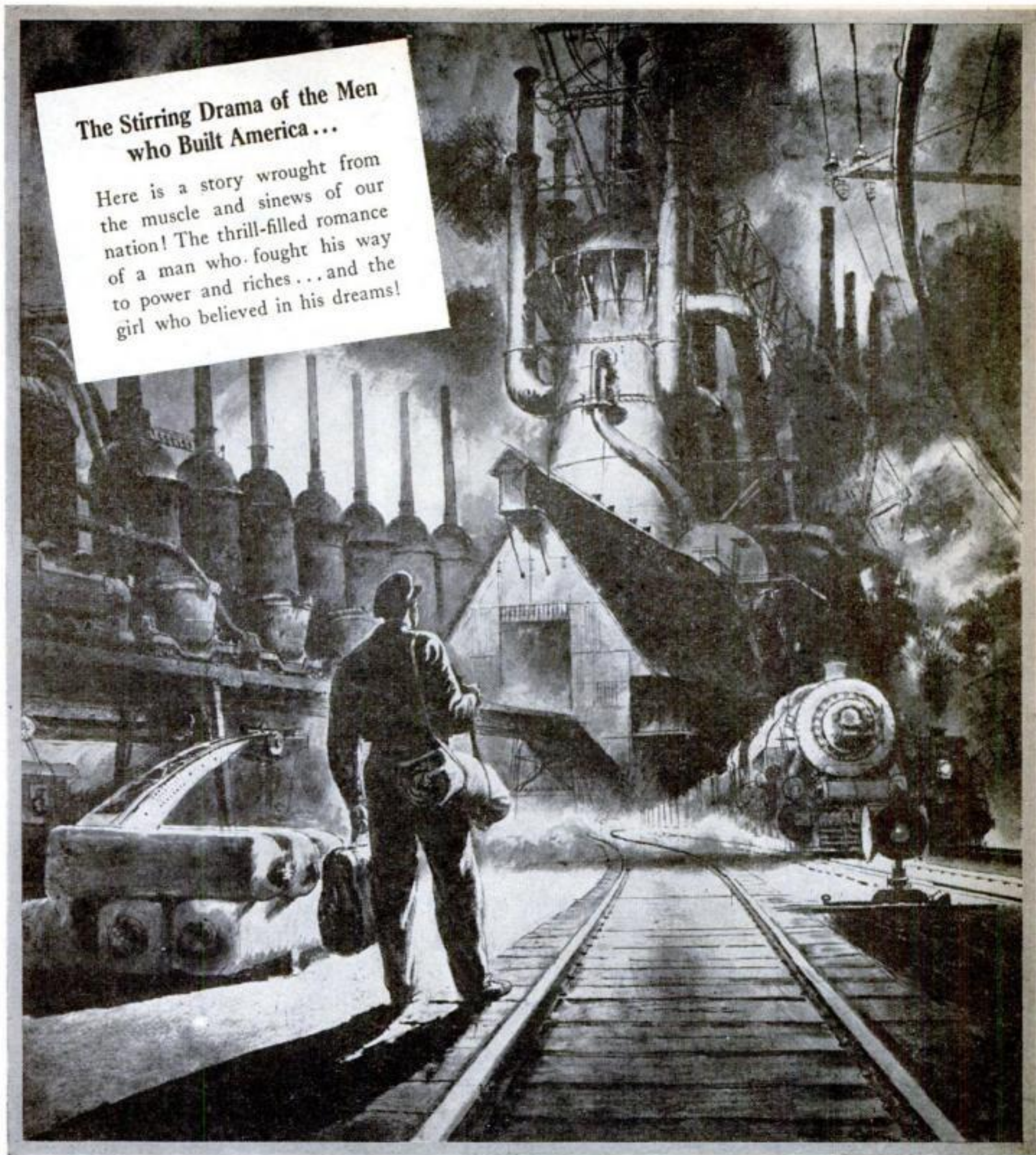
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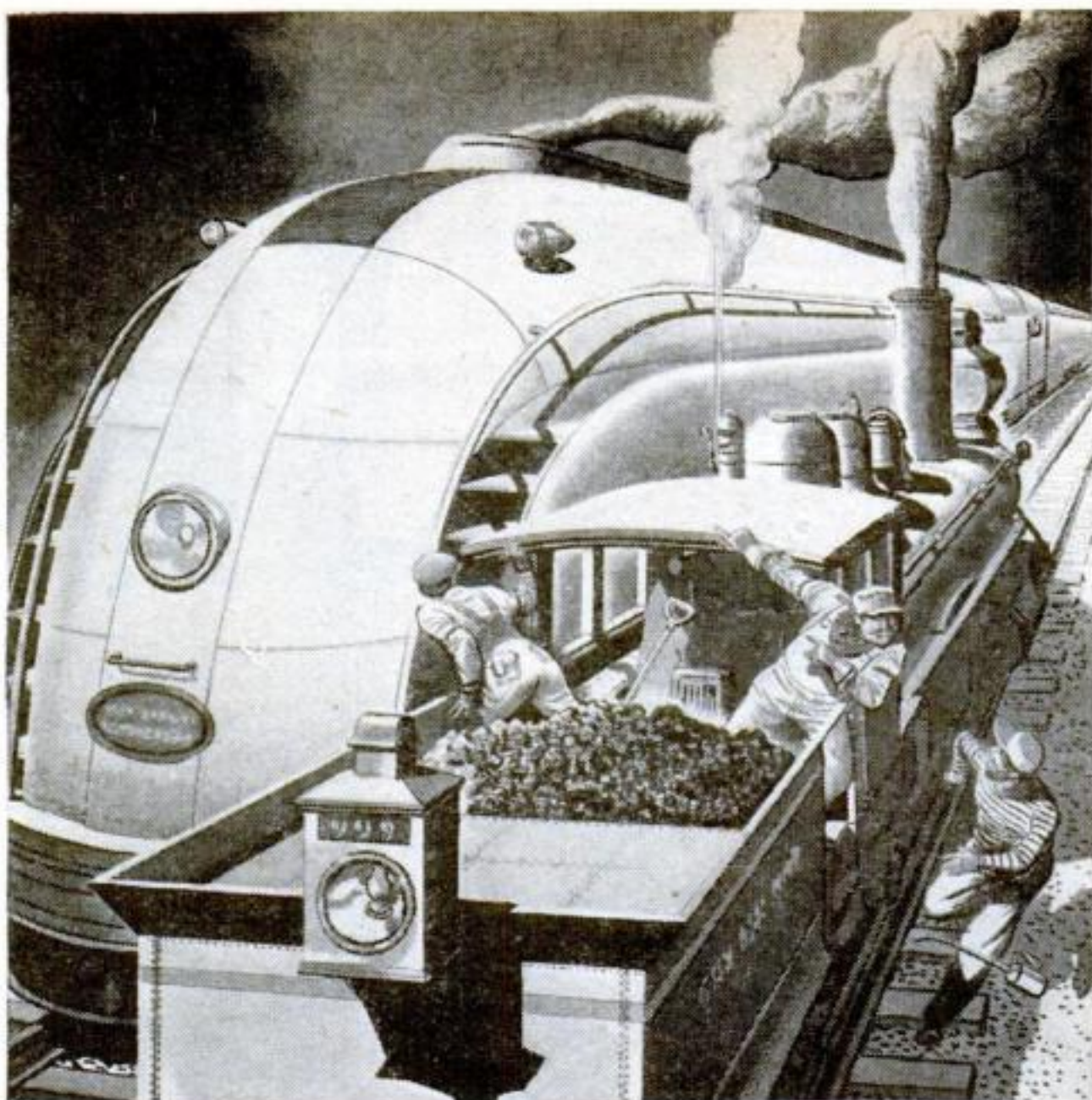


NOVEMBER, 1944

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THERE'S BEEN A BIG CHANGE



★ For years old "999" was undisputed champion of locomotive design and performance. But she couldn't keep up with progress.

For years nobody challenged the efficiency of the conventional tapered roller bearing, either—until transportation and industry heaped increasing burdens on bearing service.

It's the rollers that carry the load. And Tyson

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The Tyson "All-Rolls" design is leading the progress parade by doing many tough jobs better—and lasting longer—than bearings with fewer rollers. The big name in bearings today is . . . TYSON!



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COUNT THE ROLLS • THE ROLLS COUNT

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TODAY'S HEAVY-DUTY BEARING



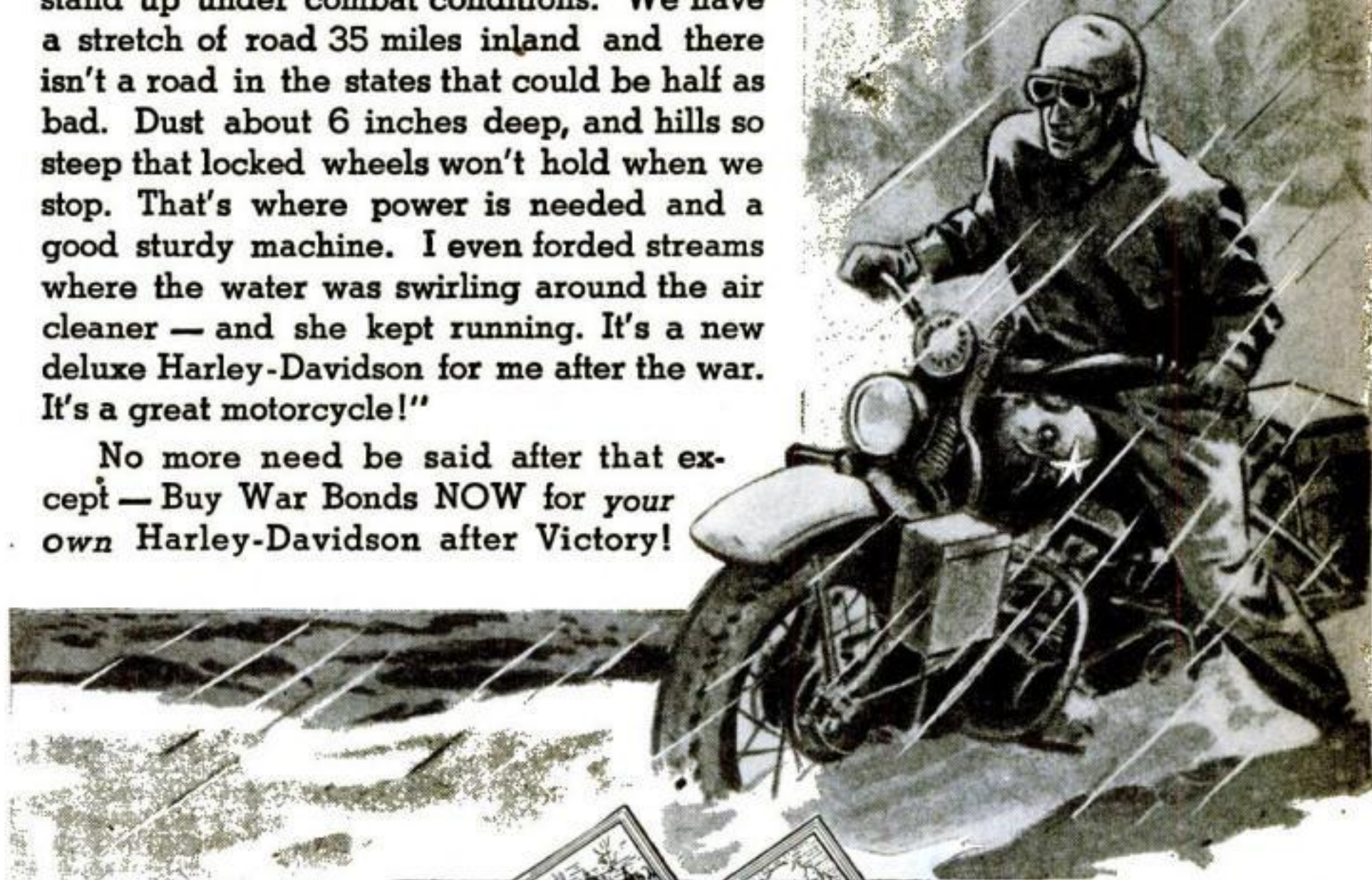
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One of the finest tributes Harley-Davidson Motorcycles ever received is in this letter from T/Cpl. E. J. E., in the Pacific area:

"It's miraculous how Harley-Davidsons stand up under combat conditions. We have a stretch of road 35 miles inland and there isn't a road in the states that could be half as bad. Dust about 6 inches deep, and hills so steep that locked wheels won't hold when we stop. That's where power is needed and a good sturdy machine. I even forded streams where the water was swirling around the air cleaner — and she kept running. It's a new deluxe Harley-Davidson for me after the war. It's a great motorcycle!"

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Send a
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"HOW-TO-
DO-IT"
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From the keen, edge-holding teeth, to the correctly shaped handle, Atkins Handsaws have the fine points so much appreciated by men who know and like to use good saws. So if you can't get an Atkins at the moment (because Atkins men and material are still largely at war) keep checking with your hardware dealer. When you get your saw, you'll be glad you waited!

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SAWS



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You may never need to hold a life raft together with Weldwood Glue, but you'll find it's the handiest adhesive you ever used at your home work bench.

In fact, this easy-to-use plastic resin glue is a honey for hobbyists. Mixed just by adding tap water to the powder, it can be used immediately, is cold-setting (work can be handled in a few hours) and it makes a *permanent* bond!

Waterproof, rot-proof and bacteria-proof, Weldwood glue won't stain, or mar the most delicate color or finish.

Your hardware store or lumber dealer has handy packages of Weldwood Glue in 10¢, 25¢, 50¢ and 85¢ (1 lb.) sizes. Get a can today or send 25¢ and your dealer's name for a trial 3½ oz. sample. Supply limited, due to Uncle Sam's war needs.

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WATERPROOF GLUE

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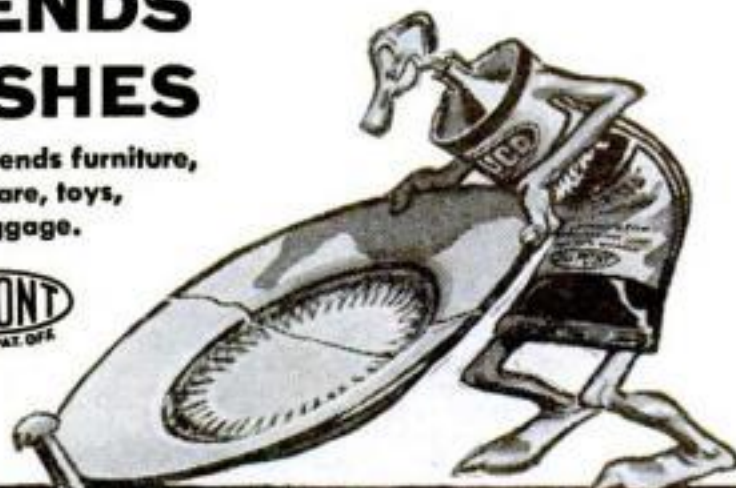
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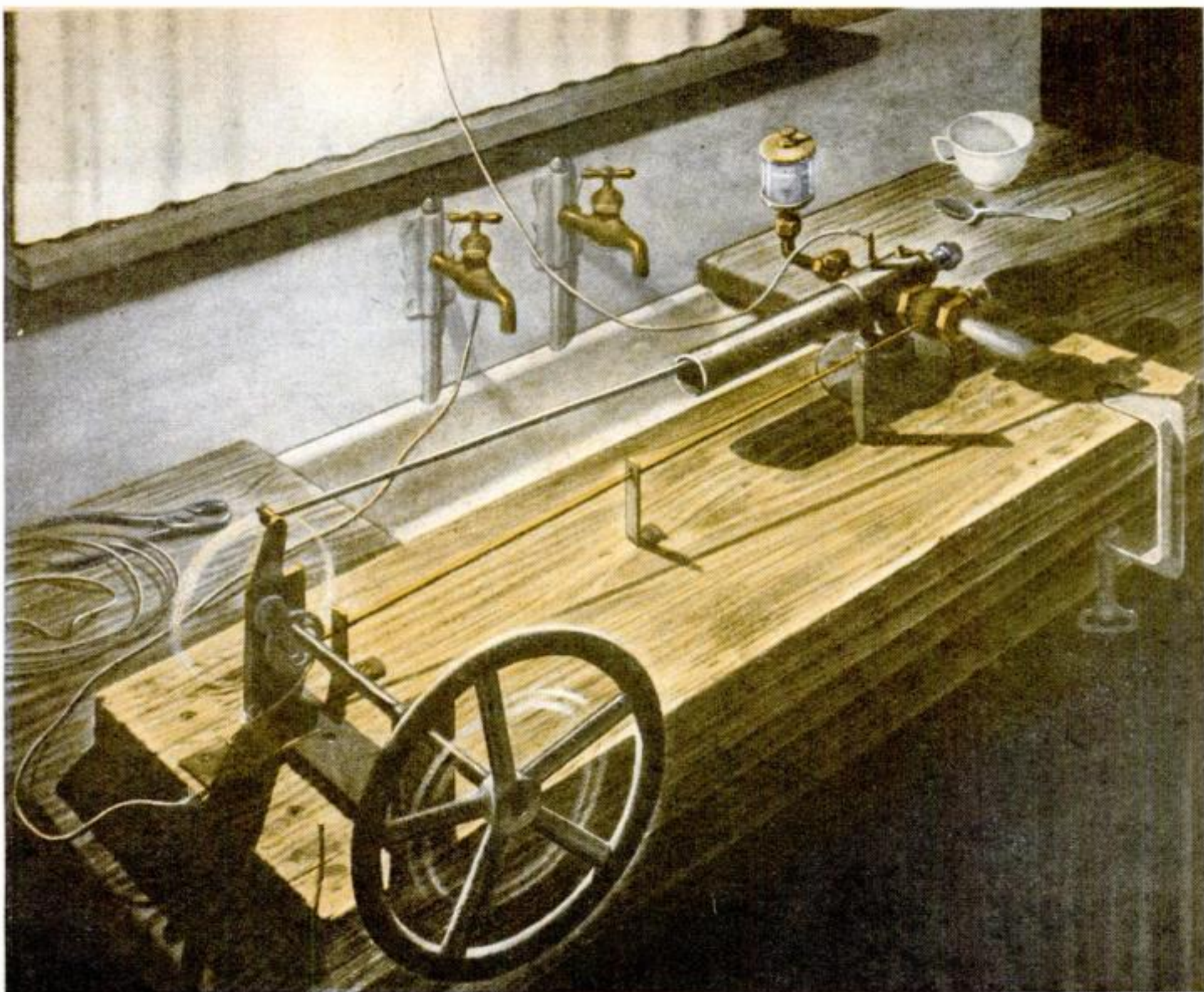
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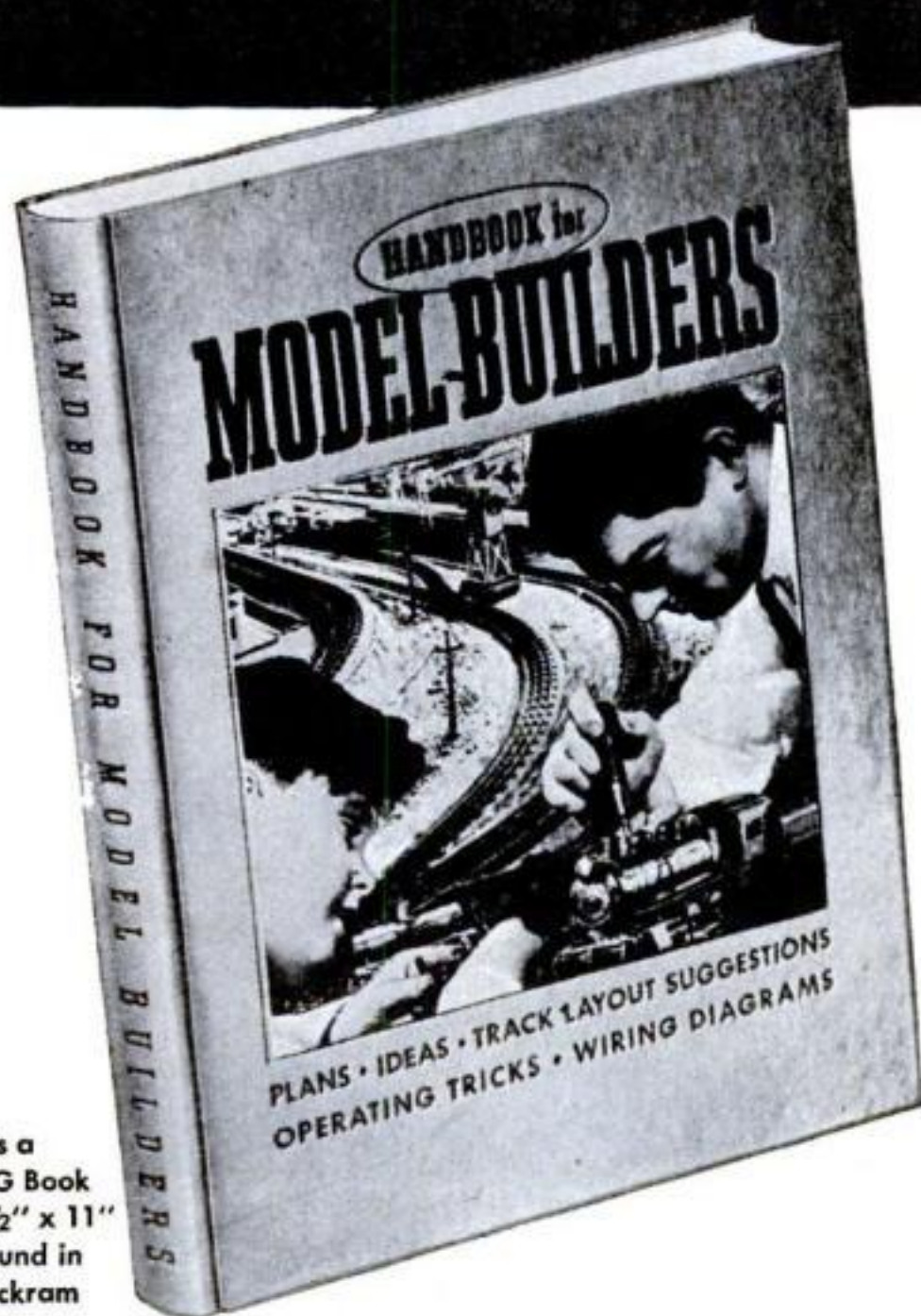
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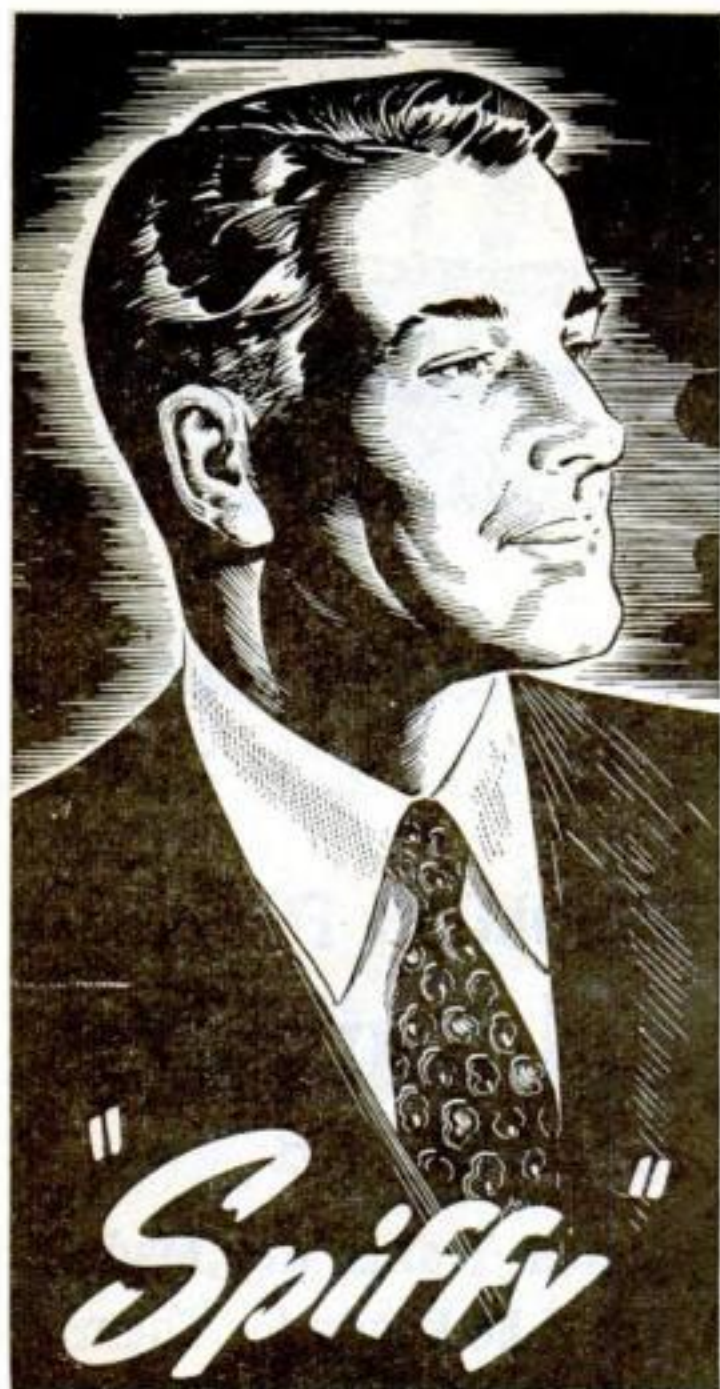
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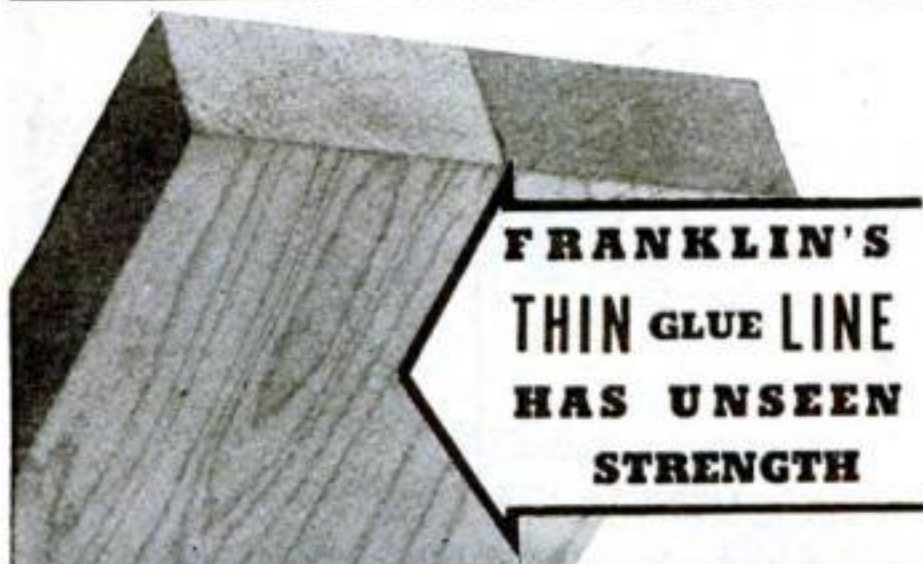


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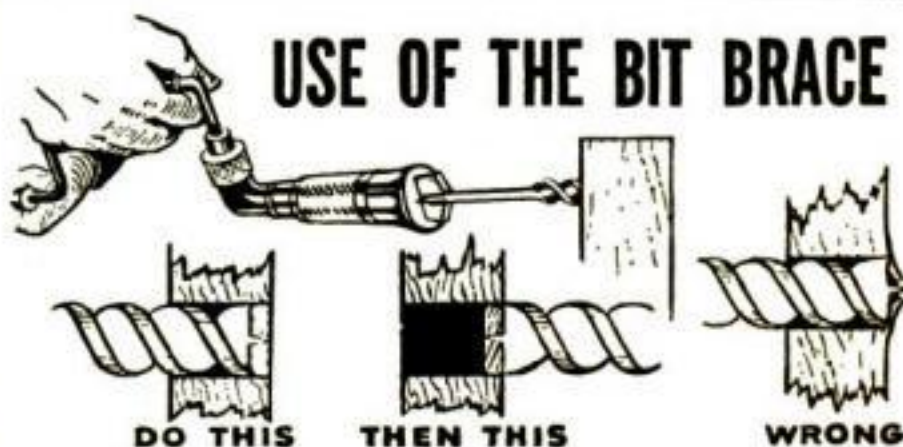
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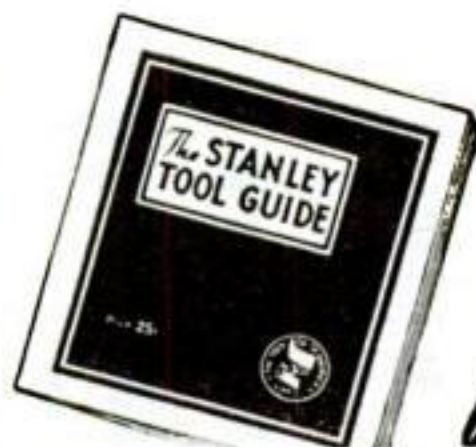
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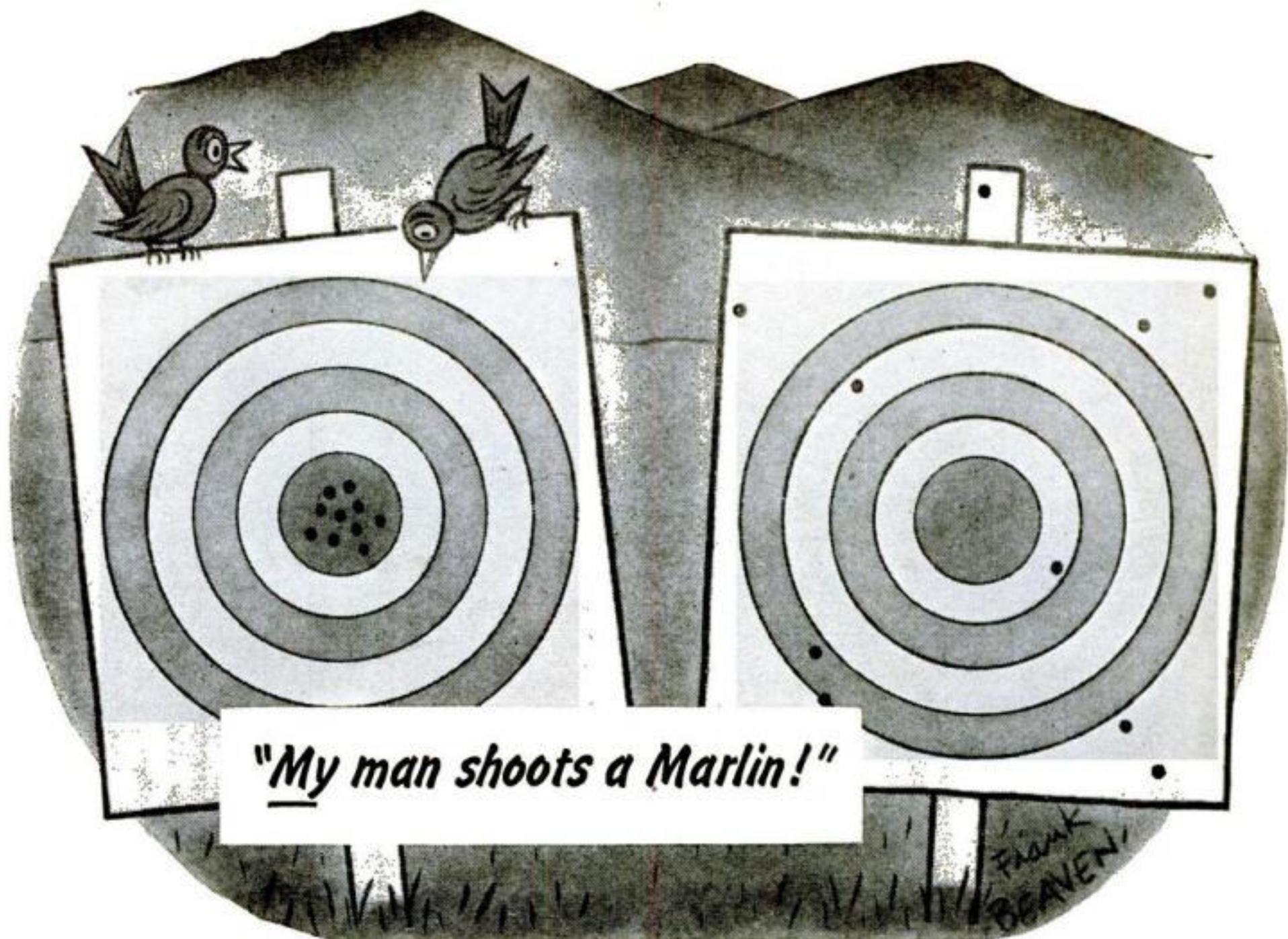
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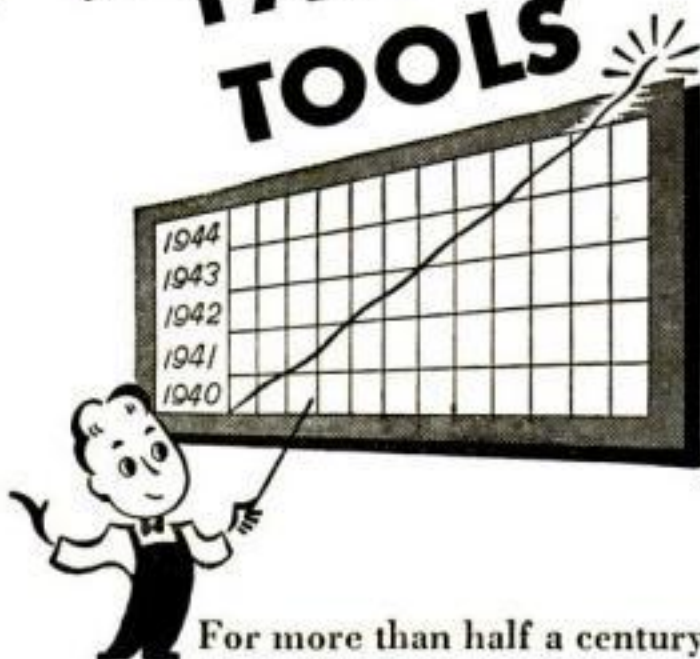
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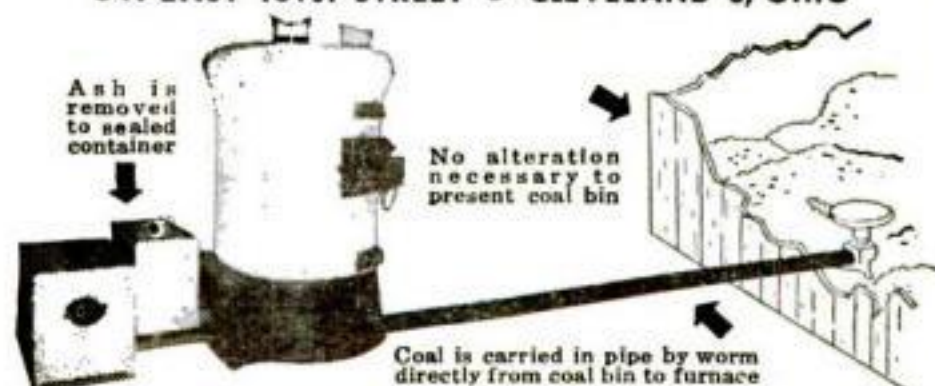
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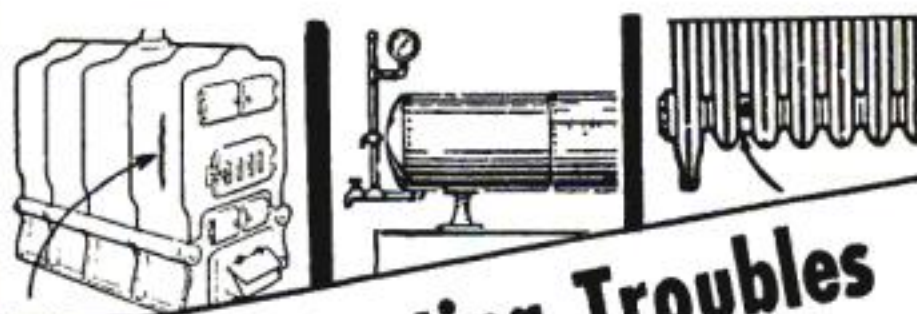
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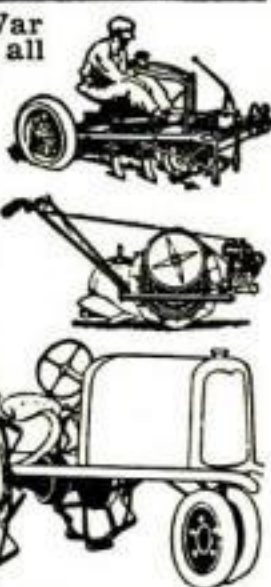
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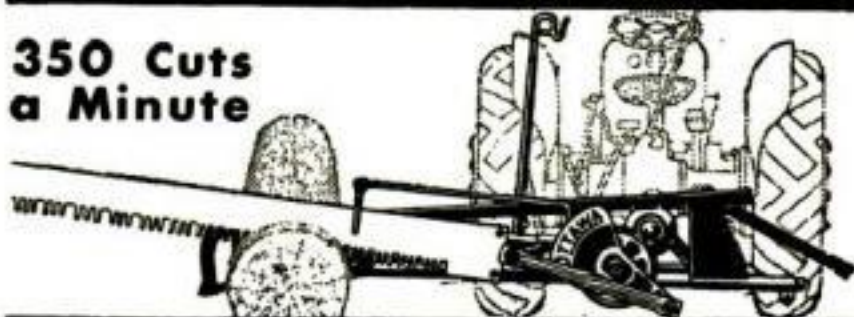
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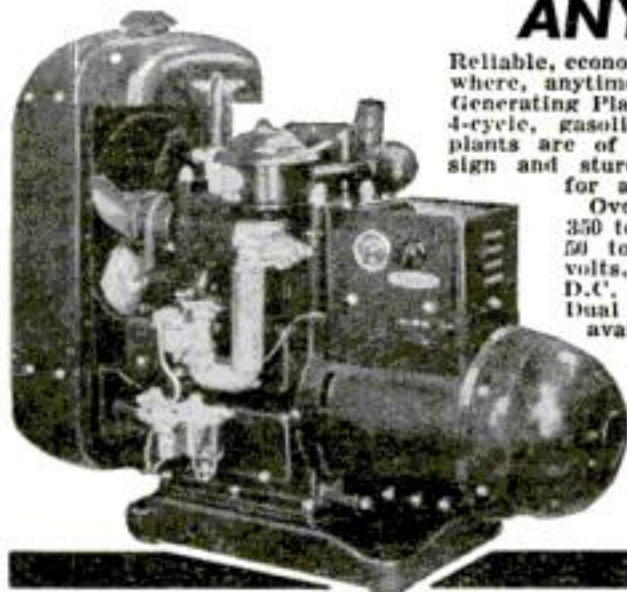
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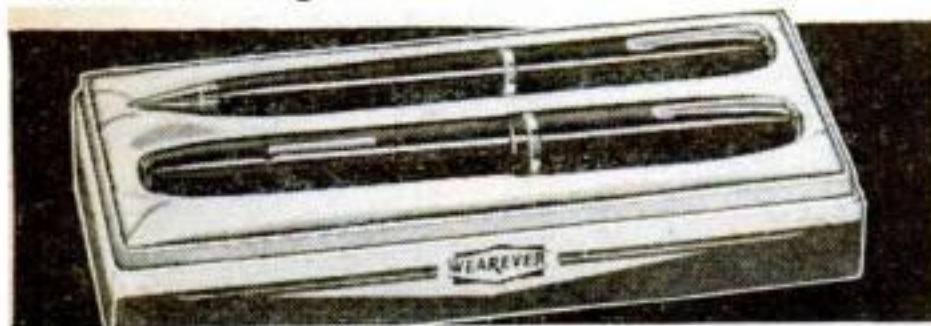
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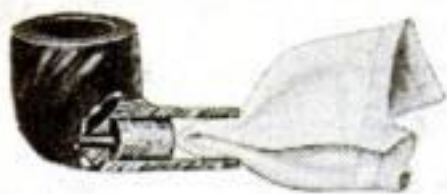
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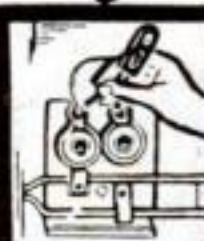
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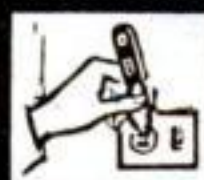
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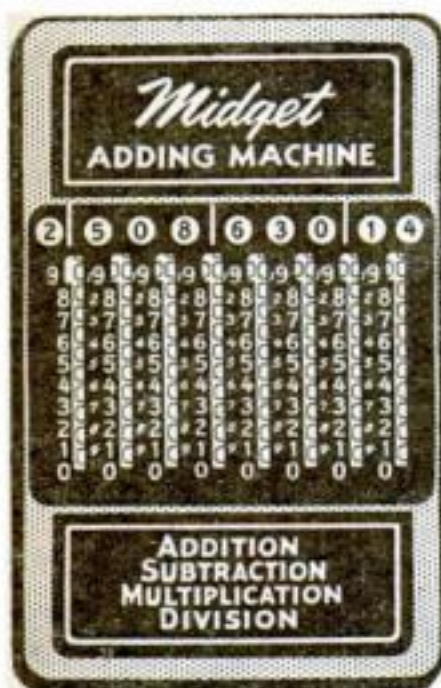
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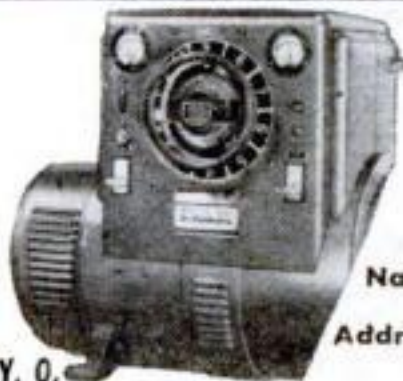
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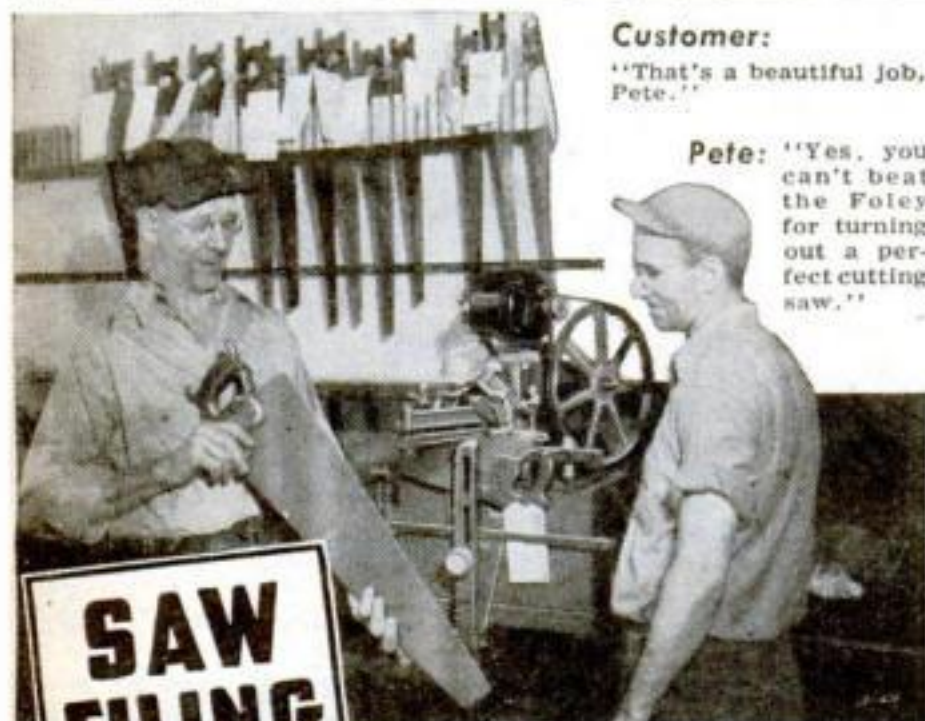


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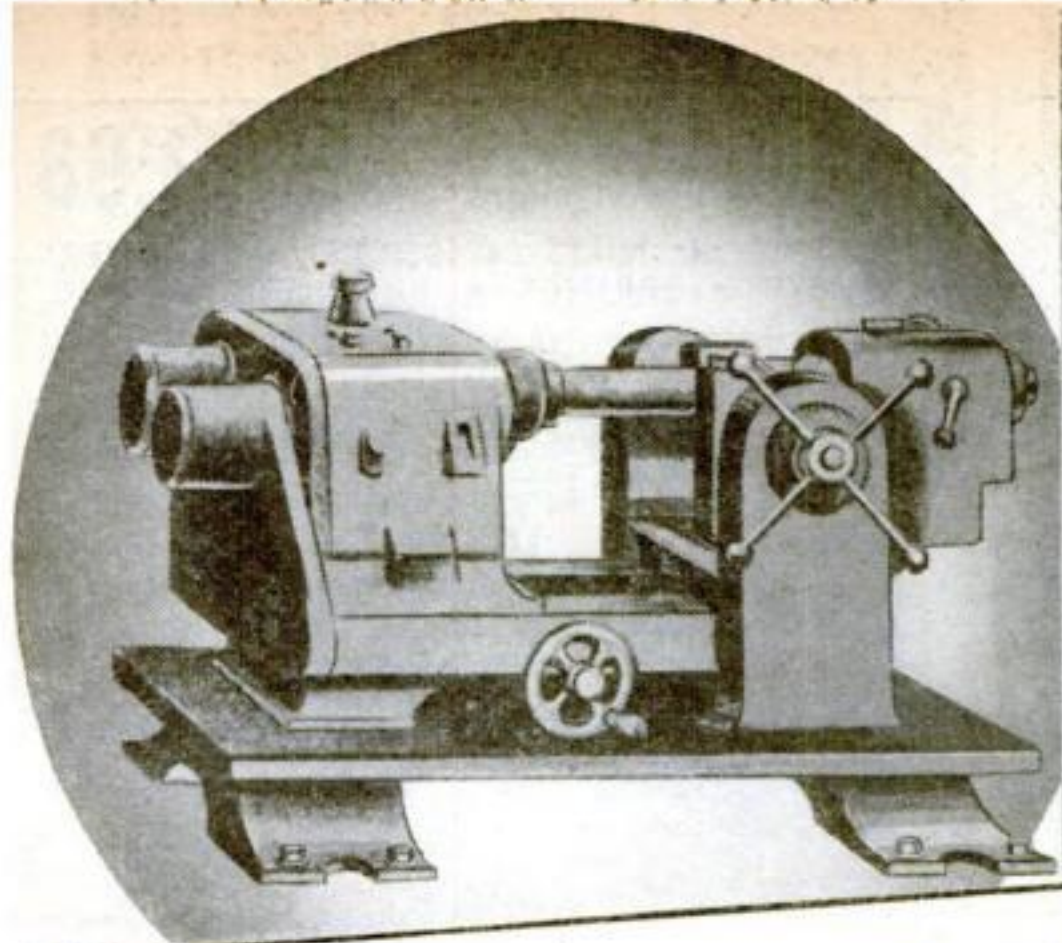
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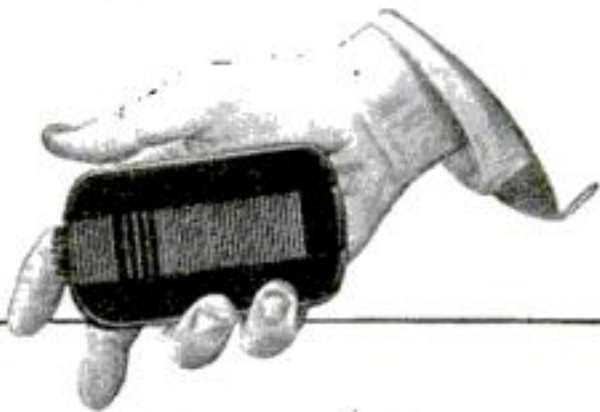
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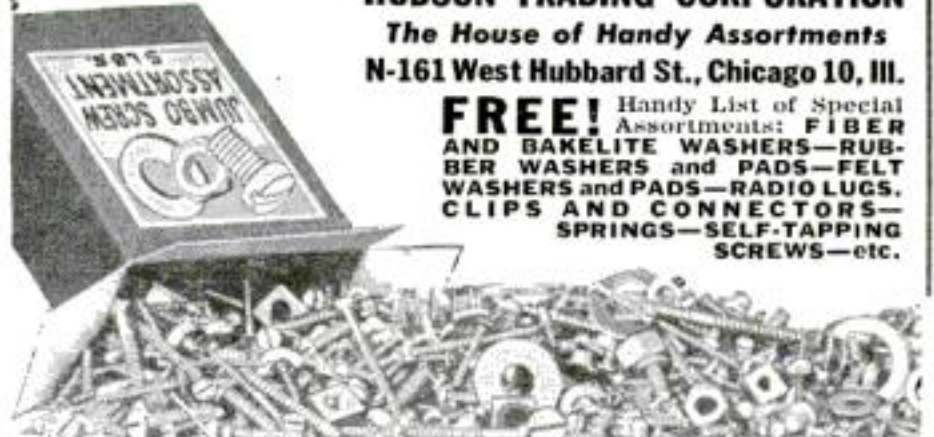
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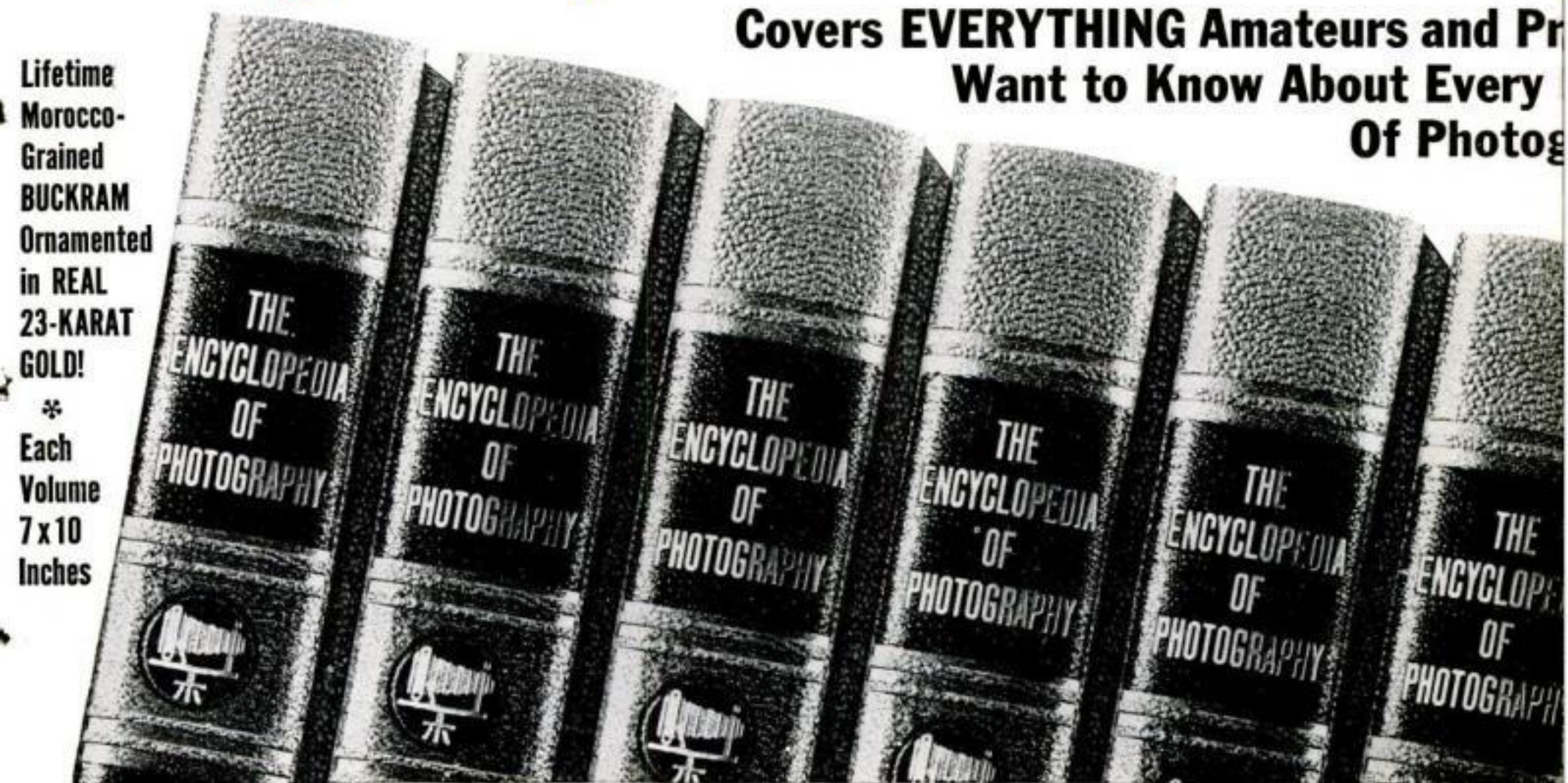
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